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ABSTRACT

Designed to provide instructional materials for use by vocational agriculture teachers, this unit contains nine lessons based upon competencies needed to maximize profits in corn production. The lessons cover opportunities for growing corn; seed selection; seedbed preparation; planting methods and practices; fertilizer rates and application; weeds, insects, and diseases of corn; harvesting and storing corn; marketing corn; and production economics. Each lesson contains the following: (1) a performance objective, (2) teaching-learning activities (including technical content), (3) supplementary materials (including transparency masters and lists of references), and (4) check-out activities. Suggestions for using problem-solving procedures, resource persons, field trips, and audio-visual aids are outlined in the sections on teaching-learning activities provided for each lesson. Transparency masters of charts, tables, and illustrations are included in each lesson. (Related documents contain similar instructional materials on breeding livestock, livestock judging, feeding livestock, dairy housing and equipment, and tobacco production--see note.) (MN)

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CORN PRODUCTION

A Unit for Teachers of Vocational Agriculture

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CORN PRODUCTION

Number of Class Periods _______________ Month(s) _______________

INTRODUCTION

Maximizing profits in corn production requires competence in many areas. Determining the competencies that are required for growing corn is an important but difficult job. Fortunately this job has already been done as part of the National Agricultural Occupations Competency Study, and those results are the basis for the lessons used in this unit. Since in the validation of the competencies by incumbent workers the importance of the competencies were rated, you, the teacher, have solid data on which to base what is taught, how much time to spend on each lesson, and what can be eliminated. Copies of the study are available in most vocational agriculture departments in Kentucky or can be used at the universities or State Department of Education.

Lessons found in this unit are based upon competencies in growing corn and are adapted from the National Agricultural Occupations Competency Study. They are as follows:

1. Opportunities for Growing Corn
2. Seed Selection
3. Seedbed Preparation
4. Planting Methods and Practices
5. Fertilizer Rates and Application
6. Pests--Weeds, Insects, and Diseases of Corn
7. Harvesting and Storing Corn
8. Marketing Corn
9. Production Economics

DIRECTIONS

Each lesson listed is followed by: 1) a performance objective, 2) teaching-learning activities (including technical content), 3) supplementary materials (including transparency masters and lists of references), and 4) check-out activities. Since the knowledge that can be obtained in each of these lessons is necessary to be a successful corn producer, all the lessons should be taught unless local circumstances or previous learnings would cause this to be unnecessary. They do not necessarily need to be taught in the order listed.

1. OPPORTUNITIES FOR GROWING CORN

1.1 Performance Objective

Given a written check-out activity concerning corn growing opportunities, the student will complete the check-out activity with 80 percent accuracy.

1.2 Teaching-Learning Activities

a. This section on opportunities for growing corn can best be taught using the problem-solving procedure. Prepare appropriate problems for class use.

b. Use transparencies made from transparency masters (see Supplementary Materials later in this section) to acquaint students with information about corn production. Some of these can be reproduced as handouts and given to students to put in their notebooks.

c. Obtain materials that can be displayed in the classroom to inform students and increase interest and motivation. Examples of materials to obtain are: corn seed bags, seed tags, planter plates, posters advertising seed, seed, and ears of corn.

d. Take a field trip to see corn being produced.

e. Use a good farmer to talk to the class about corn production. A very progressive farmer that has been written up in farm magazines will be more impressive, if such a person is available.

1.2.1 Recognize advantages and disadvantages of corn production.

a. Corn production in the United States.

Corn is king as a field grain; however, in 1979, soybean acreage exceeded corn acreage for the first time. (See transparency masters 1.2.1a and 1.2.1b) Corn still has a greater dollar value than beans or any other feed grain and is the leader in concentrates fed. (See transparency master 1.2.1c) The acreages and production of corn and soybeans in millions of acres and billions of bushels (not available for 1979) for 1974 and 1969 were as follows:

Crop	Millions of Acres			Billions of Bushels	
	1979	1974	1969	1974	1969
Corn	69.5	61.6	52.5	4.4	4.4
Soybeans	70.7	48.1	38.5	1.1	1.0

The U. S. production of corn in 1978 was 7,081,849,000 bushels, a new record, again. The average yield broke a 100 bushels per acre at 101 bushels per acre.

Production of corn for grain in 1977 was approximately 6,357,000,000 bushels which set a new record for the third consecutive year. The 1977 record crop was a result of higher yields that more than offset a slight reduction in harvested acres. The U. S. yield averaged 90.8 bushels per acre, nearly a 3-bushel increase from 1976. About 70 million acres of corn were harvested for grain in 1977 and an additional 9.3 million acres were cut for silage for almost 80 million acres harvested in 1977. The value of corn can be seen in transparency master 1.2.1d.

b. Corn production in Kentucky.

Corn continues to be the leading grain crop in Kentucky. As an important feed crop, it has had good demand as beef production has increased in the State. The high prices and demand for soybeans have caused them to compete with corn for acreage and passed corn in number of acres in 1979. The dollar value of corn is still greater than soybeans. (See transparency master 1.2.1e) The following chart shows comparisons between the two crops for 1976 according to Kentucky Crop Statistics.

Crop	Millions of Acres Planted	Millions of Acres Grain Harvested	Bu./Acre	Millions of Bushels
Corn	1.5	1.7	102.0	138.7
Soybeans	1.1	1.0	26.5	28.3

Corn is rather tolerant to many types of climatic conditions and is less susceptible to crop failure than a crop like soybeans.

The per acre profit from corn is less than many labor intensive crops like tobacco. This may make corn less desirable than some other crops on farms where labor is to be marketed through crops. (See transparency masters 1.2.1f, 1.2.1g and 1.2.1h.)

1.2.2 Interpret the trends in corn production.

Increased corn production over the past few years has more than kept pace with increased demand for exports. Larger carry-overs became more common during the late 1970's. The total demand for U. S. corn has increased over the past few years. The continued demand domestically and increase in exports appear to forecast a reasonably good outlook for corn. One rather poor crop year could completely wipe out present carry-overs and raise prices considerably.

Production for 1979 is estimated at about 7.2 billion bushels, and exports are expected to be about 2.5 billion bushels. Both total bushels and percent of the corn crop exported are continuing to improve.

1.2.3 Recognize the importance of corn production in daily living and identify special uses of corn.

It has been pointed out that corn is an extremely important crop in terms of number of acres grown, feed value to livestock, and dollar value of the crop. (See transparency master 1.2.1g.) This makes corn an important source of income to many farmers and good feed for livestock. Since it is important in feeding livestock, it is important to all who raise or eat livestock. Corn is used in the production of many products such as cooking oils, margarine, corn meal, and cereals. Since exports of corn are substantial (over 1.5 billion bushels per year on the average the last few years), it is a factor in the important balance of trade with other nations.

1.2.4 Identify occupational opportunities related to corn production.

Since corn production occupies so many acres of cropland, it follows that producing corn furnishes many jobs. This fact is somewhat offset by decreasing acreage and increasing efficiency. Another problem in becoming a corn producer is that it often requires large outlays of capitol unless one works for someone else or is a share-cropper with the landowner furnishing almost everything but labor.

Corn is a low labor consuming crop. Many acres can be leased and corn grown on the land. If harvesting is hired and no-tillage techniques are used, the labor requirements are lowered still further.

1.3 Supplementary Materials

References: 1. Kentucky Agricultural Statistics, 1977-78.

2. Modern Corn Production.

3. Producing Farm Crops.

4. 1978 Handbook of Agricultural Charts.

Slide set: "Grow Top Profit Corn."

Transparency Masters: 1. 1.2.1a, "Corn Supply and Disappearance Graph."

2. 1.2.1b, "Corn Supply and Disappearance Chart."

3. 1.2.1c, "Feed Concentrates Fed."

4. 1.2.1d, "Corn Prices."
5. 1.2.1e, "Kentucky Distribution of Crop Values, 1977."
6. 1.2.1f, "State Summary - Agronomic Crops."
7. 1.2.1g, "1979 Grain Crop Production Cost Estimates."
8. 1.2.1h, "Costs Per Acre of Producing Corn."

1.4 Check-Out Activities

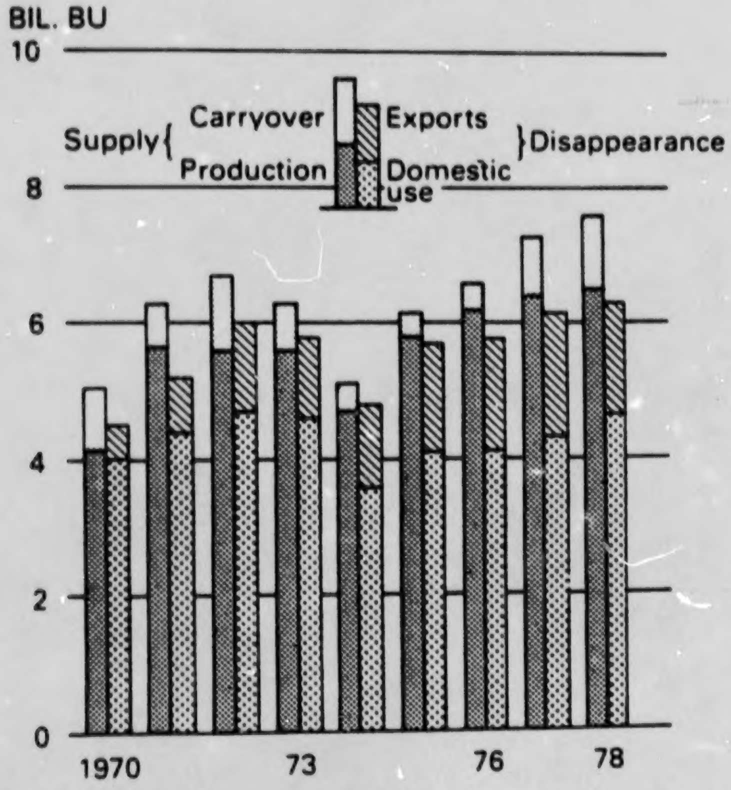
Provide students with the following exercises:

1. One disadvantage of growing corn is that it is not tolerant of many types of climate conditions. T F
2. Total bushels of corn produced has been relatively constant the last few years. T F
3. Demand for corn has remained relatively constant the past few years. T F
4. Corn is an important source of income for many farmers. T F
5. In 1977, corn production exceeded 8.1 billion bushels. T F
6. The occupational opportunities are bright for corn production since it can normally be done with very limited capital.

ANSWERS:

1. False
2. True
3. True
4. True
5. False
6. False

CORN SUPPLY AND DISAPPEARANCE



Supply includes small volume of imports 1977 estimated 1978 midpoint of projected ranges 1978 forecast Year beginning October 1

Source: 1978 Handbook of Agricultural Charts.

TM 1.2.1b

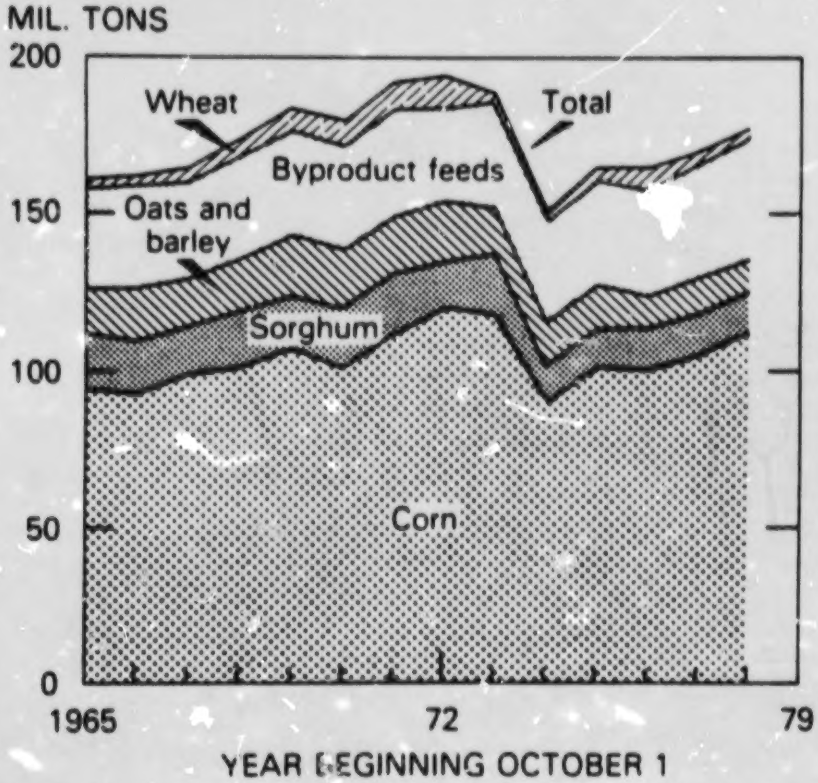
Corn Supply and Disappearance[1]

	1975	1976	1977[2]	1978[3]
		Million bushels		
Supply	6,192	6,668	7,257	7,832
Production	5,829	6,266	6,371	6,824
Imports[6]	2	3	2	1
Carryover	361	399	884	1,007
Gov't.[4]	0	0	0	0
"Free"[5]	399	884	1,007	1,362
Use	5,993	5,784	6,150	6,320
Domestic	4,082	4,100	4,300	4,570
Exports[6]	1,711	1,684	1,950	1,900

[1] Year beginning October 1. [2] Preliminary. [3] Based on August indications. [4] Uncommitted inventory. [5] Privately owned stocks; residual. Includes total government loans (original and reseal). [6] Includes grain equivalent of products.

Source: 1978 Handbook of Agricultural Charts.

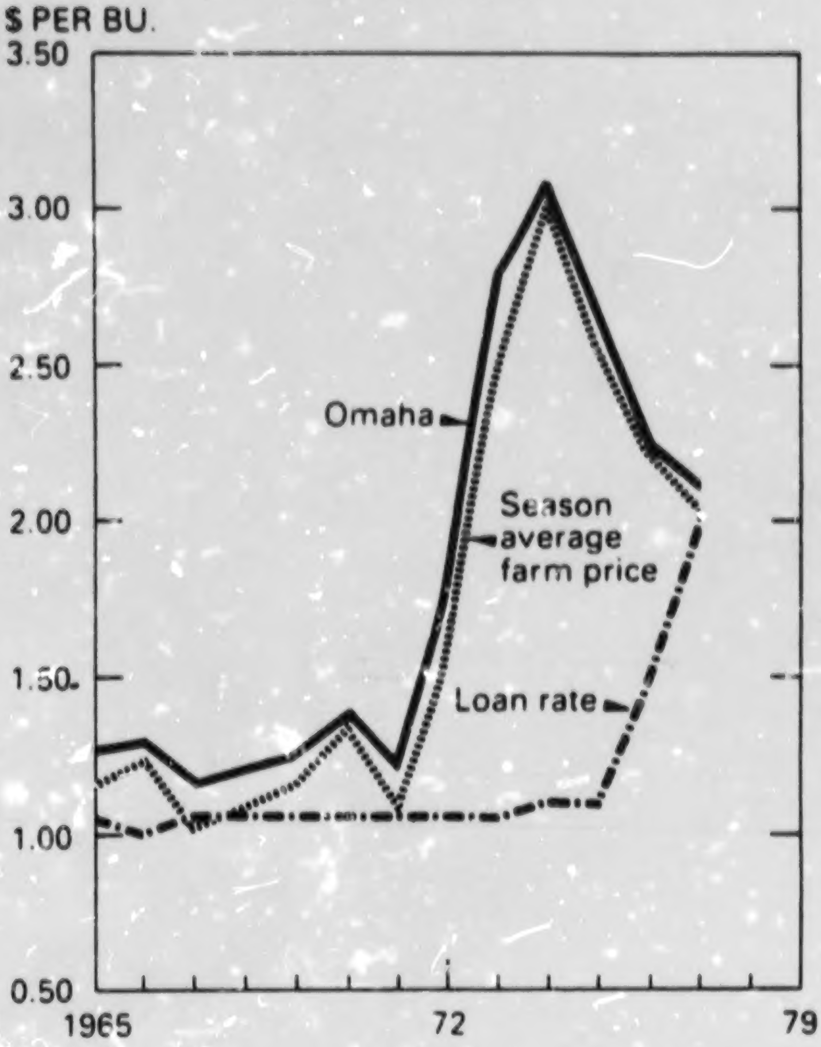
FEED CONCENTRATES FED



Feed fed to livestock and poultry. 1977 figures are preliminary. 1978 based on August indications.

Source: 1978 Handbook of Agricultural Charts.

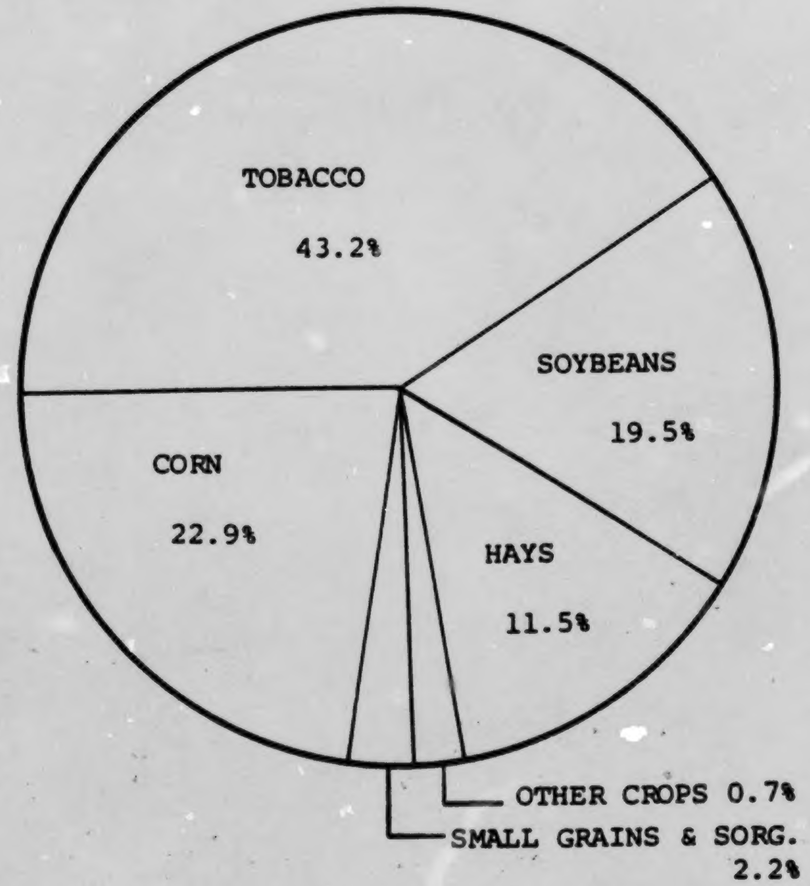
CORN PRICES



1976 October July 1977 October August Year beginning October 1

Source: 1978 Handbook of Agricultural Charts.

KENTUCKY
DISTRIBUTION OF CROP VALUES
1977



Source: Kentucky Agricultural Statistics: 1977-1978.

STATE SUMMARY - AGRONOMIC CROPS

Base Year 1972

Crop	Acres	Av. Yield Per Acre	Total Production	Total Value (Dollars)
Tobacco (burley)	156,000	2,675 lbs.	417,300,000 lbs.	338,847,600
Tobacco (dark)	16,250	1,811 lbs.	29,425,108 lbs.	16,015,738
Cotton	5,000	397 lbs.	1,985,000 lbs.	545,875
Corn	968,000	86 bu.	83,248,000 bu.	94,319,984
Grain Sorghum	20,000	68 bu.	1,360,000 bu.	1,183,200
Soybeans	924,000	27 bu.	24,948,000 bu.	73,846,080
Wheat	216,000	32.5 bu.	7,020,000 bu.	10,319,400
Barley	70,000	40 bu.	2,800,000 bu.	2,828,000
Oats	10,000	41 bu.	410,000 bu.	315,700
Rye	3,000	29 bu.	87,000 bu.	113,970

1980 Potential

Crop	Acres	Av. Yield Per Acre	Total Production	Total Value (Dollars)
Tobacco (burley)	171,600	2,675 lbs.	459,030,000 lbs.	72,732,360
Tobacco (dark)	16,250	1,811 lbs.	29,425,108 lbs.	16,015,738
Cotton	3,500	700 lbs.	2,450,000 lbs.	673,750
Corn	1,515,639	96 bu.	145,501,344 bu.	164,416,519
Grain sorghum	40,000	78 bu.	3,120,000 bu.	2,714,000
Soybeans	1,806,468	33 bu.	59,613,444 bu.	176,455,579
Wheat	297,888	45.4 bu.	13,524,115 bu.	19,880,449
Barley	111,813	68.3 bu.	7,636,828 bu.	7,713,196
Oats	15,000	60 bu.	900,000 bu.	693,000
Rye	2,000	33 bu.	66,000 bu.	86,460

Long-Term Potential

Crop	Acres	Av. Yield Per Acre	Total Production	Total Value (Dollars)
Tobacco (burley)	187,200	2,675 lbs.	500,760,000 lbs.	406,617,120
Tobacco (dark)	16,250	1,811 lbs.	29,425,108 lbs.	16,015,738
Cotton	2,000	800 lbs.	1,600,000 lbs.	440,000
Corn	2,731,448	114 bu.	311,385,072 bu.	351,865,131
Grain sorghum	80,000	90 bu.	7,200,000 bu.	6,264,000
Soybeans	2,487,161	46 bu.	114,409,406 bu.	338,651,842
Wheat	662,998	53 bu.	35,138,894 bu.	51,654,174
Barley	290,531	74.5 bu.	21,644,456 bu.	21,860,901
Oats	15,000	72 bu.	1,080,000 bu.	831,600
Rye	2,000	40 bu.	80,000 bu.	104,800

Source: Agricultural Potentials for Kentucky

TM 1.2.1g

1979 GRAIN CROP PRODUCTION COST ESTIMATES

			Corn (Conv.)	Soybeans (S.C.)	Beans + Wheat (D.C.)	Wheat
A.	Cash Costs					
	1. Nitrogen (150 lb.)		$ 27.00	$ 1.00	$ 10.80	$10.80
	2. P and K		13.50	13.50	20.25	13.50
	3. Lime		3.00	3.00	3.00	3.00
	4. Seed		13.00	12.00	27.00	15.00
	5. Chemicals	$(21.00)*	15.50	15.00	15.00	-
	6. Mach. Opn.	(12.00)	16.00	16.00	28.00	16.00
	7. Ins. and Repairs	(7.20)	7.80	6.00	9.75	4.50
	8. Marketing		15.00	6.00	9.75	6.00
	Total	$(111.20)	$110.80	$72.50	$123.55	$68.80
B.	Overhead Costs					
	1. Mach. Deprec.	$ (11.50)	$14.50	$12.50	$ 17.50	$10.00
	2. Bldg. Deprec.		6.25	3.75	7.50	2.50
	3. Land Charge		40.00	40.00	40.00	32.50
	4. Other interest	(10.81)	12.60	9.01	14.63	6.75
	5. Taxes		7.40	7.00	7.60	5.60
	Total	$ (75.95)	$80.75	$72.26	$ 87.22	$57.35
C.	Labor ($3.00)	$ (9.00)	$13.50	$13.50	$ 21.00	$10.50
D.	Total Cost	$(196.15)	$203.05	$158.75	$231.77	$136.65
E.	Expected Returns - 2 Levels					
	Level 1:					
	1. Yield/acre (bu)		110	40	30 + 40	40
	2. Price/bu		$ 2.25	$6.25	$6.25 $3.00	$3.00
	3. Gross/acre		$247.50	$250.00	$187.50 + $120.00	$120.00
	Level 2:					
	1. Yield/acre (bu)		100	35	25 + 35	35
	2. Price/bu		$ 2.25	$6.25	$6.25 $3.00	$3.00
	3. Gross/acre		$225.00	$218.75	$156.25 + $105.00	$105.00
G.	Net Returns (1)	$ (51.35)	$ 42.45	$ 91.25	$ 75.73	-$ 16.65
	(2)	$ (28.85)	$ 19.95	$ 60.00	$ 29.48	-$ 31.65
H.	Above Cash Costs:					
	(1)	$(136.30)	$136.70	$177.50	$183.95	$ 51.20
	(2)	$(113.80)	$114.20	$146.25	$137.70	$46.20

*( ) = No-till costs when different for corn.

Source: Agricultural Economics Sheets.

COSTS PER ACRE OF PRODUCING CORN

	CORN (100 BUSHELS)
VARIABLE COSTS	
FERTILIZER AND LIME	41.00
SEED	14.00
MACHINERY OPERATION	15.00
CHEMICALS	12.00
TOTAL VARIABLE COSTS	$82.00
FIXED COSTS	
MACH. AND EQUIP. DEPRECIATION	34.00
BUILDING DEPRECIATION	11.00
LABOR CHARGE	10.00
LAND CHARGE	75.00
TAXES	5.00
TOTAL FIXED COSTS	$135.00
TOTAL ALL COSTS	$217.00

2. SEED SELECTION

2.1 Performance Objective

Given four situations for growing corn (these may be real sites and conditions, written descriptions, slides, transparencies, or combinations of the above), and four varieties of corn from which to choose, the student will select the best variety for all four situations as verified by the instructor.

2.2 Teaching-Learning Activities

a. This section on seed selection can best be taught using the problem-solving procedure. Prepare appropriate problems for class use.

b. Take a field trip to the National Farm Machinery Show and have students talk with seed corn company representatives and gather materials to use in class. In recent years, there have been more than 30 companies with booths advertising seed corn.

c. Use materials collected for section one of this unit and materials collected at the National Farm Machinery Show to illustrate how many types of corn seed there are to choose from.

d. Use a good seed corn company representative as a resource person.

e. Use transparencies made from transparency masters (see Supplementary Materials later in this section) to aid students in learning about seeds. You may want to run handouts of some of these materials for students to include in their notebooks.

f. Secure corn planter, seed hopper or planter plate to show class. A planter could be assembled for a dealer as a class project.

2.2.1 Select the desired seed corn, considering maturity, harvest-ability, disease resistance, lodging resistance, insect resistance, and yield level. The best source of information is the Agricultural Experiment Station.

a. Maturity -- A variety should be physiologically mature 10 days or more before frost. A variety that matures too early will usually yield less and some years may lodge more because of stalk rots. Growing a variety with very late maturity may result in yield loss from frost or spoilage if it is harvested and stored at high moisture levels.

b. Harvest-ability -- Several factors need to be considered in harvest-ability of corn:

(1) Moisture of grain at harvest.
(2) Ease with which ears can be removed from stalk.
(3) Ease with which kernels can be removed from cob.
(4) Height of ear on stalk.
(5) How well stalk stands up for picking.

c. Disease resistance -- Most problems are caused by Northern leaf blight (Helminthosporium Turcicum), Southern leaf blight (Helminthosporium Maydis), MDM (Maize Dwarf Mosaic), corn smut, stalk rots (Gibberella, Diplodia, Fusarium, and Nigrospora), and MCDV (Maize Chlorotic Dwarf Virus).

d. Lodging or standability -- A maximum of 10 percent lodging should occur in any year. Since harvest is now by machine, standability is absolutely essential. Some of the causes of standability problems are disease, insect damage, and improper plant population.

e. Insect resistance -- Variety selected should be resistant to corn borers.

f. Yield level -- Yield level is not a simple, inherited, easily predicted characteristic. No one can tell from the number of ears, size of ear, number of kernel rows, length of ear, or kernel size whether one hybrid will outyield another hybrid. Check performance test records for several years in your area and weigh yields on your own farm.

g. Terminology in seed corn and kinds of hybrid crosses (See transparency masters 2.1.1a, 2.1.1b, and 2.1.1c).

2.2.2 Interpret planting charts on the seed corn bag to obtain proper planting.

a. There is an increasing use of plateless planters, and in the future it is expected that most corn will be planted with plateless planters. The bag label for plateless planter round seed is PPR.

b. To get a more accurate seed drop with a plate-type planter, it is recommended that you check each of the following:

(1) Check plates, floor plates, and planter parts for wear, rust, and malfunctions.
(2) Adjust gear speeds when changing plates, such as from 24 cell to 16 cell.
(3) Check planting speed. Speed in excess of 5 m.p.h. may cause problems (and/or require a plate with larger cells).
(4) Check kernel drop as you plant. This is the best check you can make to verify that the plate is working properly under field conditions.

(5) If the drop is too light, turn the groove side of the floor plate toward seed, if it was down, or refer to the chart for a larger plate.
(6) If the drop is too heavy, turn the smooth side of the floor plate toward seed, if it was up, or refer to the chart for a smaller plate.

c. Most seed corn companies have their own systems of categorizing seed sizes in both rounds and flats. The size of the seed is listed on the bag or a tag and charts like the ones shown on transparency masters 2.2.2a and 2.2.2b are usually included on the bag or on a tag.

2.2.3 Read and evaluate the tag on a bag of seed corn. (See transparency master 2.2.3a and 2.2.3b.)

Items included on the seed tag are:

a. Variety: This will give you information about approximate yields to expect and maturity dates. Maturity dates should not be longer than the growing days in the area where the corn is to be grown.

b. Origin: State where corn seed was produced.

c. Date Tested: Month germination test was conducted.

d. Germination: Percent of seeds that will sprout.

e. Kernel Count: Approximate number of kernels in the bag.

f. Other Information: Pure seed -- percent corn seed;
Inert matter -- percent dirt and other matter not crop or weed seed;
Other crop seed -- percent crops other than corn but not weeds;
Weed seed -- total percent of all weeds;
Noxious weed seeds -- percent of those weeds classified as noxious;
Seed treatment information is given on the tag.

2.2.4 Calculate the number of units of seed corn needed to plant a fixed number of acres at various population levels and the cost of the seed. Units are often 50-pound bags or are bags with a given number of seeds in them.

The following chart gives useful information showing the planting rate for various harvest populations. It is assumed that 15 percent of the plants will not survive to harvest. The correct population should be based on the variety you plant, fertility and moisture conditions, and should consider your crop goal. The chart also shows how far apart the kernels will be in various row widths. (See transparency master 2.2.4a). The cost per thousand kernels is based on cost per unit and number of kernels per unit (see transparency master 2.2.4b).

2.2.5 Determine the length of maturity of various hybrids sold by an individual seed corn company.

Many tags on seed corn bags list the days to maturity. Most seed corn companies have information which tells the maturity of each variety. Many companies also have charts that compare the maturity of their corn to other well-known varieties (see transparency master 2.2.5a).

Another way to express maturity rather than number of days from planting to harvest is to use the number of heat units required. The hybrid industry has generally adopted a uniform maturity rating system for hybrid seed corn. Known as heat units, the system is based on the high and low temperatures for each day from planting until physiological maturity. Physiological maturity is the point at which the maximum amount of dry matter has been accumulated in the kernel, which is approximately 35 percent moisture. Heat units are accumulative from day to day (see transparency master 2.2.5b).

The formula used is:

$$\frac{\text{Maximum daily temperature + Minimum daily temperature}}{2} - 50 = \text{heat units}$$

For a day with a high of 82° F and a low of 64° F, heat units are calculated as follows:

$$\frac{82 + 64}{2} - 50 = 23 \text{ heat units}$$

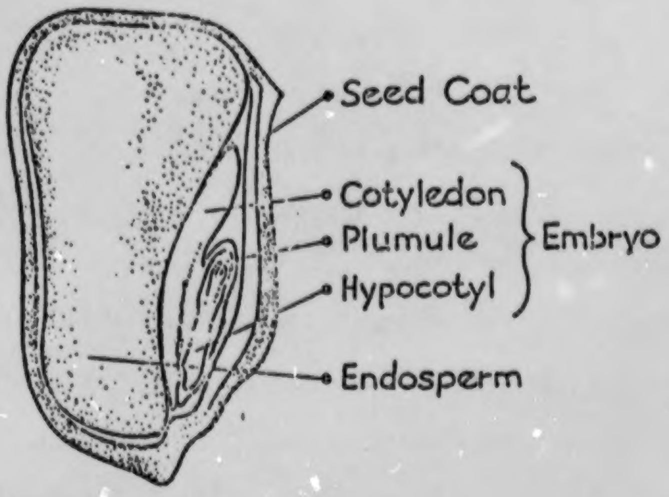
Most corn growth occurs between 86 and 50 degrees. Consequently temperatures above 86 are counted as 86° F and temperatures below 50 are counted as 50° F. For example, on a day with a high of 89 and a low of 47, the heat units would be calculated as follows:

$$\frac{86 + 50}{2} - 50 = 18 \text{ heat units}$$

Another term used instead of heat units is growing degree days. A good publication is available from the University of Kentucky, Agricultural Experiment Station, called Growing Degree Days for Corn in Kentucky. It is available on a single copy basis from the Cooperative Extension Bulletin Office.

2.2.6 Identify the parts of corn kernels and discuss functions of each part (see transparency master 2.2.6a).

STRUCTURE OF A CORN SEED
(MONOCOTYLEDON)



The function of the seed parts are as follows:

Seed coat is the protective outer layer or skin. At germination the embryo forms a new plant. The cotyledon becomes the seed leaves, the plumule is the primary bud, and the hypocotyl develops into plant roots.

2.3 Supplementary Materials

References:
1. Crop Production.
2. Growing Degree Days for Corn in Kentucky, Progres Report 197.
3. Kentucky Hybrid Corn Performance Test - 1978, Progress Report 238.
4. Modern Corn Production.
5. Northrup King Hybrid Corn.
6. The Migro Complete Corn Farmers Handbook.

7. 1979 Hybrids - Southern States.

NOTE: Most seed corn companies put out handbooks which contain valuable information. See listing under List of Resources at the end of the unit.

Movies:
1. "Genetics of Tomorrow."
2. "Golden Link."
3. "Growing the Good Seeds."
4. "Hybrid Vigor: Key to Abundance."
5. "Picking the Winners."
6. "The Man - The Record."
7. "Today's Choice."

Slides: "Seed Production of Corn, Soybeans, and Small Grains."

Transparency Masters:
1. 2.2.1a, "Terminology in Seed Corn."
2. 2.2.1b, "Kinds of Hybrid Crosses - Double Cross."
3. 2.2.1c, "Kinds of Hybrid Crosses - Three-Way Cross."
4. 2.2.2a, "Plates Suggested for Flat Kernels."
5. 2.2.2b, "Plates Suggested for Round Kernels."
6. 2.2.3a, "Items Included on a Seed Tag."
7. 2.2.4a, "Plant Population."
8. 2.2.4b, "Seed Cost Per Thousand Kernels at Various Unit Prices and Seed Counts."
9. 2.2.5a, "Hybrid Corn Relative Maturity Comparison Chart."
10. 2.2.5b, "Examples of Figuring Daily Heat Units."
11. 2.2.6a, "Structure of a Corn Seed."

2.4 Check-Out Activities

Provide the students with four situations for growing corn (these may be real sites and conditions, written descriptions, slides, transparencies or combinations of the above) and four varieties to choose from (the student will select seed for each situation).

TERMINOLOGY IN SEED CORN

Type - A group of varieties so similar that individual varieties cannot be told apart, except under test conditions.

Strain - A term sometimes used to designate an improved selection of a variety.

Blend - A term sometimes applied to mixtures of lots of seed within or between varieties but is not the same as a variety.

Common - A term applied to seed that cannot be identified as to a particular variety, and is usually a mixture.

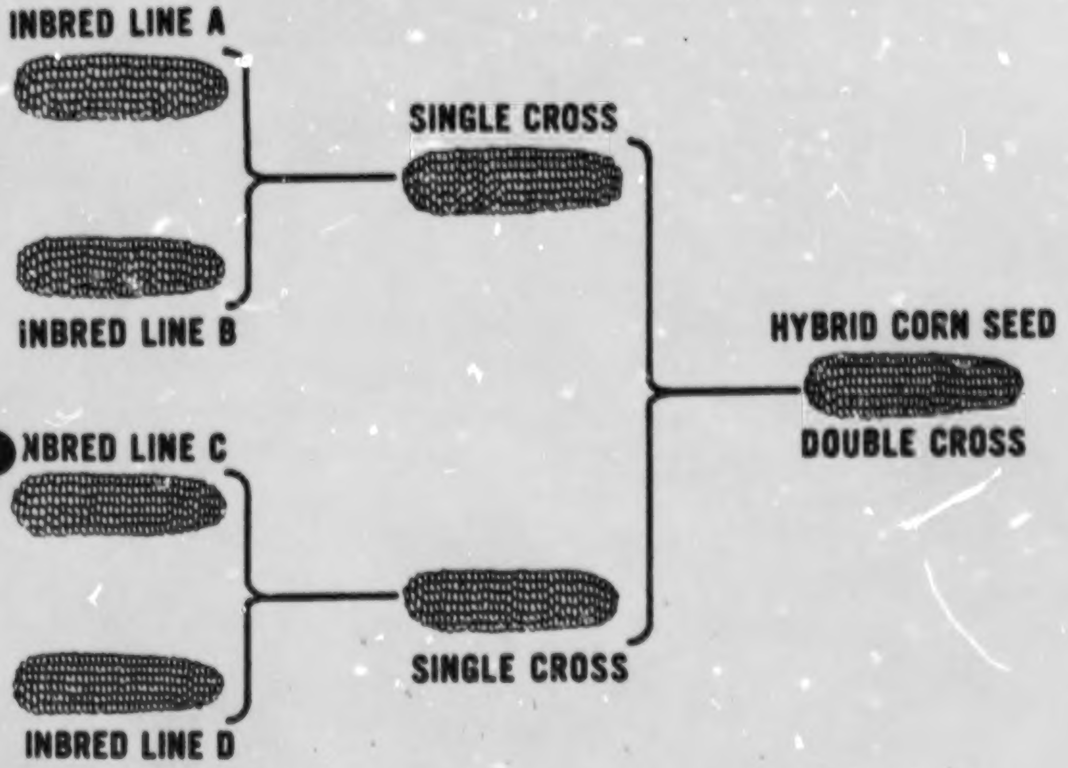
Brand - The trademark of a particular seed company. The brand precedes the variety name. Variety names cannot be trademarked.

Hybrid - A term sometimes confused with variety. Hybrid refers to a method of producing seed involving certain type crosses. Corn hybrids are identified by a number or a combination of numbers and letters.

Source: Seed Production.

KINDS OF HYBRID CROSSES

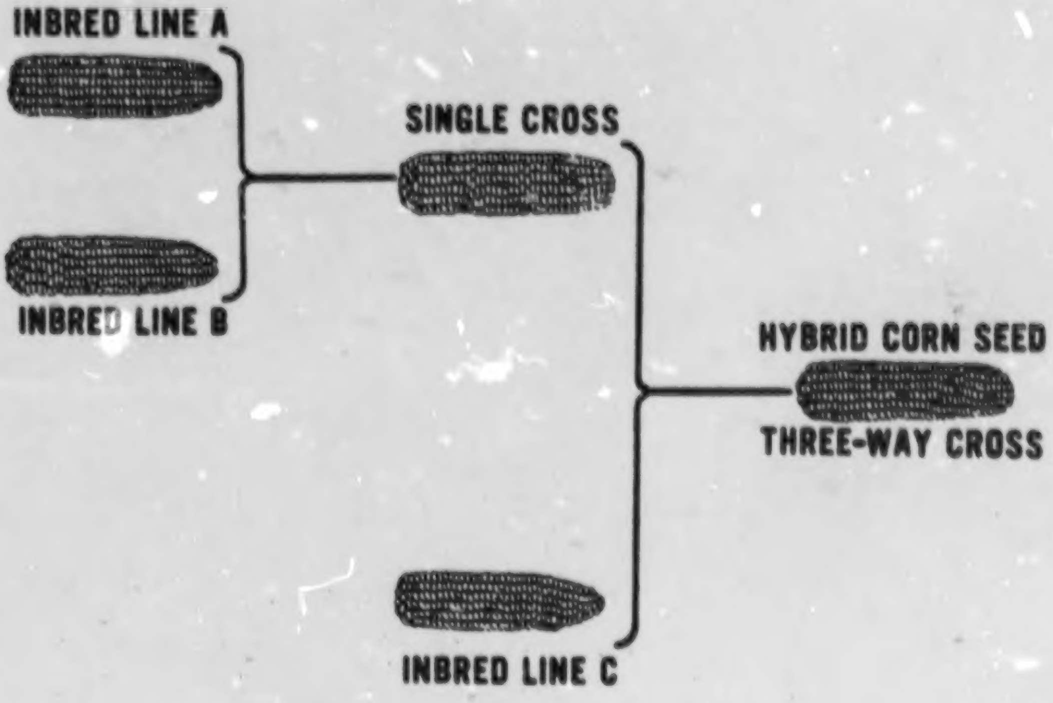
-Double Cross


INBRED LINE A
INBRED LINE B
SINGLE CROSS
INBRED LINE C
INBRED LINE D
SINGLE CROSS
HYBRID CORN SEED
DOUBLE CROSS

Source: Seed Production.

KINDS OF HYBRID CROSSES

-Three-Way Cross


INBRED LINE A
INBRED LINE B
SINGLE CROSS
HYBRID CORN SEED
THREE-WAY CROSS
INBRED LINE C

Source: Seed Production.

PLATES SUGGESTED FOR FLAT KERNELS

	F-1	F-2	F-3	F-4	F-5	F-6	F-7	F-8	F-9	F-10	F-11	F-12
JOHN DEERE												
16 Cell Metal	2156*	2156	2503	2504	695	1572	694	697	697	1571	1268	
16 Cell Plastic	B5-16*	B5-16	B13-16	B11-16	B8-16	B12-16	B7-16	B6-16	B6-16	B10-16	B9-16	B19-16
24 Cell Metal	2594*	2594	2847	2848	950	2711	1302	30070	30070	16237	16236	
24 Cell Plastic	B5-24X*	B5-24X	B13-24	B11-24	B8-24X	B12-24	B7-24X	B6-24X	B6-24X	B10-24	B9-24X	B19-24
INTERNATIONAL												
16 Cell Metal	1979*	1978*	1978	1978	1977	1975	1977	3546	3546	3236	3236	
16 Cell Plastic	C8-16*	C8-16*	C8-16	C11-16	C7-16	C6-16	C65-16	C10-16X	C10-16X	C697-16	C9-16	C19-16
24 Cell Metal	474665*	469811*	469811	469811	469810	469809	480189	480691	480691	480190	480190	
24 Cell Plastic	C18-24*	C8-24*	C8-24	C11-24	C7-24	C6-24	C65-24	C10-24	C10-24	C697-24	C9-24	C19-24
FORD												
20 Cell Metal	126785*	109787*	109787	109788*	109786	108955	109786	108954	108954	108954	108954	
24 Cell Plastic (1)	B5-24X*	B5-24X	B13-24	B11-24	B8-24X	B12-24	B7-24X	B6-24X	B6-24X	B10-24	B9-24X	B19-24
ALLIS CHALMERS												
16 Cell Metal	309430*	300108*	300108	300107*	300107	309431	300106	300980	300980	309426	302605	
16 Cell Plastic (2)	B5-16*	B5-16	B13-16	B11-16	B8-16	B12-16	B7-16	B6-16	B6-16	B10-16	B9-16	B19-16
24 Cell Metal	345712*	345712	345712	344032	344032	345714	343950	347943	347943	347943	347943	
24 Cell Plastic (2)	B5-24X*	B5-24X	B13-24	B11-24	B8-24X	B12-24	B7-24X	B6-24X	B6-24X	B10-24	B9-24X	B19-24
OLIVER & M.M.												
16 Cell Metal	245512*	245512	245512	245514	245514	245510	245511	245508	245508	245506	245501	
16 Cell Plastic (3)	B5-16*	B5-16	B13-16	B11-16	B8-16	B12-16	B7-16	B6-16	B6-16	B10-16	B9-16	B19-16
CASE												
16 Cell Metal	PT428*	PT427*	PT427*	PT427	PT427	PT465	PT465	PT426	[illegible]	PT425	PT425	
16 Cell Plastic (4)	C8-16*	C8-16*	C8-16	C11-16	C7-16	C6-16	C65-16	C10-16X	C10-16X	C697-16	C9-16	C19-16
MASSEY-FERGUSON												
20 Cell Metal	440792*	440791*	440791	440788	440788	442995	440789	442995	443995	443995		
24 Cell Metal		440310	440310	440309	440309	440311	440309	440311	440311			

*SET FLOOR PLATE WITH GROOVE SIDE NEXT TO SEED.

#INDICATES FILLER RING NO. 480179 REQUIRED.

(1) "B" SERIES PLASTIC PLATES MAY BE USED IN FORD MODEL 352 1976 & LATER

(2) "B" SERIES PLASTIC PLATES MAY BE USED IN ALLIS CHALMERS WITH SPECIAL ADAPTOR

(3) "B" SERIES PLASTIC PLATES MAY BE USED IN 1968 & LATER MODELS OF WHITE (MM. OLIVER) COLE. DEMPSTER AND COCKSHUTT

(4) "C" SERIES PLASTIC PLATES MAY BE USED IN 1968 & LATER MODELS OF CASE

Source: 1979 Hybrids: Southern States.

TM 2.2.2a

Source: 1979 Hybrids: Southern States.

PLATES SUGGESTED FOR ROUND KERNELS

	R-13	R-14	R-15	R-16	R-17	R-18	R-19	R-20	R-21	R-22	R-23	R-24
JOHN DEERE												
16 Cell Metal	2820*	2820	2044*	2044	1933*	1933	1933	1933	2043	2043	2295	
16 Cell Plastic	B28-16*	B28-16	B0-16*	B0-16	B1-16X*	B1-16X	B1-16X	B1-16X*	B2-16	B25-16	B3-16X	B30-16
24 Cell Metal	2712*	2712*	2712*	2712	10853*	10853	10853	10853	2824	2824	16238	
24 Cell Plastic	B28-24*	B28-24	B0-24*	B0-24	B1-24X*	B1-24X	B1-24X	B1-24X	B2-24	B25-24	B3-24X	B30-24
INTERNATIONAL												
16 Cell Metal	462356	3613	462355*	3042	3324*	3324	3331	3561	3313	3313	3314	
16 Cell Plastic	COX-16*	COX-16	COX-16	C13-15	C1X-16*	C1X-16	C15-16	C14-16	C2X-16	C25-16	C3-16	C30-16
24 Cell Metal	489439	3043*	3043*	3043	480509#	480509#	474666	480510#	480177#	480177#	480177#	
24 Cell Plastic	COX-24*	COX-24	COX-24	C13-24X	C1X-24*	C1X-24	C15-24X	C14-24	C2X-24	C25-24	C3-24	C30-24
FORD												
20 Cell Metal	108952*	108952*	108952*	108952	108957*	108957*	108957	108957	108956	108956		
24 Cell Plastic (1)	B28-24*	B28-24	B0-24*	B0-24	B1-24X*	B1-24X	B1-24X	B1-24X	B2-24	B25-24	B3-24X	B30-24
ALLIS CHALMERS												
16 Cell Metal	344033*	344033*	344033*	344033	343561*	343561*	343561	302602	302609	302609	302606	
16 Cell Plastic (2)	B28-16*	B28-16	B0-16*	B0-16	B1-16X*	B1-16X	B1-16X	B1-16X	B2-16	B25-16	B3-16X	B30-16
24 Cell Metal	555128*	555128*	555128*	555128	555130*	555130*	555130	345713	346048	346048	555136	
24 Cell Plastic (2)	B23-24*	B28-24	B0-24*	B0-24	B1-24X*	B1-24X	B1-24X	B1-24X	B2-24	B25-24	B3-24X	B30-24
OLIVER & M.M.												
16 Cell Metal	245533*	245533	245533	245531*	245531*	245531	245528	245528	245526	245524	245523	
16 Cell Plastic (3)	B28-16*	B28-16	B0-16*	B0-16	B1-16X*	B1-16X	B1-16X	B1-16X	B2-16	B25-16	B3-16X	B30-16
CASE												
16 Cell Metal	PT467*	PT467	PT467	PT429*	PT429*	PT429	PT429	T1273	PT466	PT466	PT466	
16 Cell Plastic (4)	COX-16*	COX-16	COX-16	C13-16	C1X-16*	C1X-16	C15-16	C14-16	C2X-16	C25-16	C3-16	C30-16
MASSEY-FERGUSON												
20 Cell Metal	442994*	442997*	442997*	442997	442996*	442966*	442966	442966	440796	440796	443997	
24 Cell Metal	440310*	440310*	440310*	440310	440309*	440309*	440309	440309	44031[illegible]	440311		

*SET FLOOR PLATE WITH GROOVE SIDE NEXT TO SEED.

#INDICATES FILLER RING NO. 480179 REQUIRED.

(1) "B" SERIES PLASTIC PLATES MAY BE USED IN FORD MODEL 352 1976 & LATER

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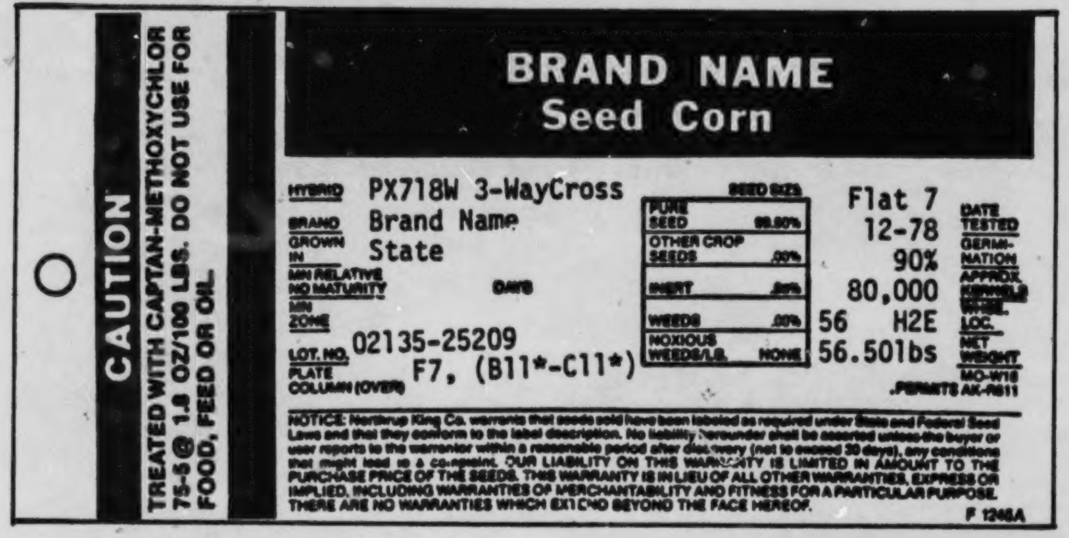
TM 2.2.2b

ITEMS INCLUDED ON A SEED TAG



CAUTION

TREATED WITH CAPTAN-METHOXYCHLOR 75-5 @ 1.8 OZ/100 LBS. DO NOT USE FOR FOOD, FEED OR OIL.

BRAND NAME
Seed Corn

HYBRID PX718W 3-WayCross
BRAND Brand Name
GROWN IN State
MN RELATIVE NO MATURITY DAYS
MN ZONE
LOT. NO. 02135-25209
PLATE COLUMN (OVER) F7, (B11*-C11*)

SEED SIZE Flat 7

PURE SEED	99.80%
OTHER CROP SEEDS	.00%
INERT	.20%
WEEDS	.00%
NOXIOUS WEEDS/LB.	NONE

DATE TESTED	12-78
GERMINATION	90%
APPROX. KERNELS	80,000
WHSE. LOC.	56 H2E
NET WEIGHT	56.50lbs

PERMITS MO-W18 AK-R611

NOTICE: Northrup King Co. warrants that seeds sold have been labeled as required under State and Federal Seed Laws and that they conform to the label description. No liability hereunder shall be asserted unless the buyer or user reports to the warrantor within a reasonable period after discovery (not to exceed 30 days), any conditions that might lead to a complaint. OUR LIABILITY ON THIS WARRANTY IS LIMITED IN AMOUNT TO THE PURCHASE PRICE OF THE SEEDS. THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. THERE ARE NO WARRANTIES WHICH EXTEND BEYOND THE FACE HEREOF.

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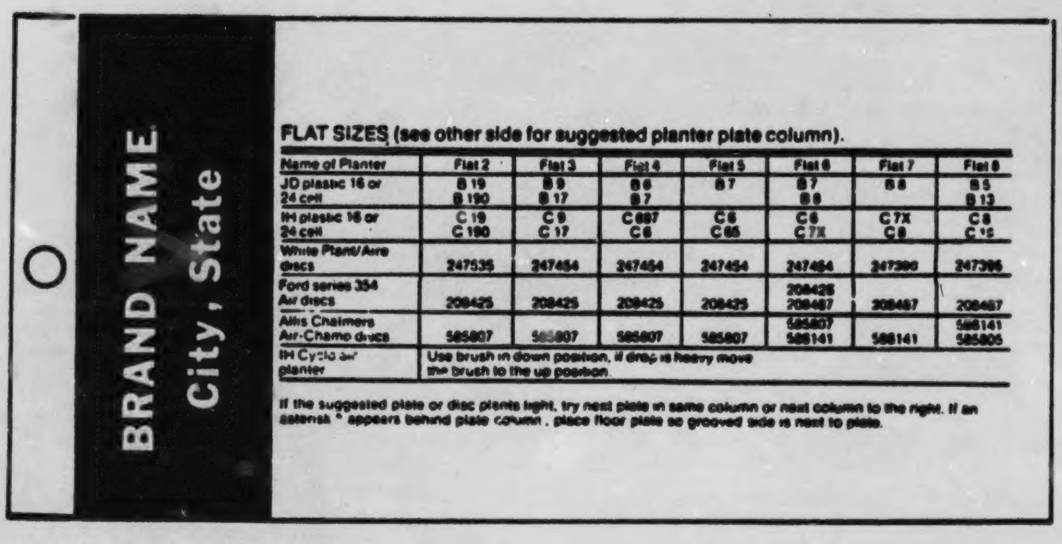


BRAND NAME
City, State

FLAT SIZES (see other side for suggested planter plate column).

Name of Planter	Flat 2	Flat 3	Flat 4	Flat 5	Flat 6	Flat 7	Flat 8
JD plastic 16 or 24 cell	B 19 B 190	B 9 B 17	B 6 B 7	B 7	B 7 B 8	B 8	B 5 B 13
IH plastic 16 or 24 cell	C 19 C 190	C 9 C 17	C 687 C 6	C 6 C 65	C 6 C 7X	C 7X C 8	C 8 C 15
White Plant/Aire discs	247535	247454	247454	247454	247454	247386	247386
Ford series 354 Air discs	208425	208425	208425	208425	208425 208487	208487	208487
Allis Chalmers Air-Champ discs	585807	585807	585807	585807	585807 585141	585141	585141 585805
IH Cyclo air planter	Use brush in down position, if drop is heavy move the brush to the up position.						

If the suggested plate or disc plants light, try next plate in same column or next column to the right. If an asterisk * appears behind plate column, place floor plate so grooved side is next to plate.

TM 2.2.4a

Plant population

Harvest population	Planting rate	Inches between kernels when planting in these row widths				
		20"	30"	36"	38"	40"
16,000	18,800	16.8	11.0	9.2	8.7	8.3
17,000	20,000	15.6	10.5	8.7	8.3	7.8
18,000	21,200	14.8	9.9	8.2	7.8	7.4
19,000	22,300	14.2	9.4	7.7	7.4	7.1
20,000	23,500	13.2	8.9	7.4	6.9	6.6
22,000	25,900	12.0	8.1	6.7	6.3	6.0
24,000	28,200	11.0	7.5	6.1	5.8	5.5
26,000	30,600	10.2	6.8	5.6	5.4	5.1
28,000	33,000	9.6	6.4	5.3	5.0	4.8
30,000	35,300	8.8	6.0	4.9	4.6	4.4

Source: Northrup King: Hybrid Corn.

SEED COST PER THOUSAND KERNELS AT VARIOUS UNIT PRICES AND SEED COUNTS

Cost	Thousand Kernels Per Unit																
Per Unit	**40**	**45**	**50**	**55**	**60**	**65**	**70**	**75**	**80**	**85**	**90**	**95**	**100**	**105**	**110**	**115**	**120**
$26.00	0.65	0.58	0.52	0.47	0.43	0.40	0.37	0.35	0.33	0.31	0.29	0.27	0.26	0.25	0.24	0.23	0.22
28.00	0.70	0.62	0.56	0.51	0.47	0.43	0.40	0.37	0.35	0.33	0.31	0.29	0.28	0.27	0.25	0.24	0.23
30.00	0.75	0.67	0.60	0.55	0.50	0.46	0.43	0.40	0.38	0.35	0.33	0.32	0.30	0.29	0.27	0.26	0.25
32.00	0.80	0.71	0.64	0.58	0.53	0.49	0.46	0.43	0.40	0.38	0.36	0.34	0.32	0.30	0.29	0.28	0.27
34.00	0.85	0.76	0.68	0.62	0.57	0.52	0.49	0.45	0.43	0.40	0.38	0.36	0.34	0.32	0.31	0.30	0.28
36.00	0.90	0.80	0.72	0.65	0.60	0.55	0.51	0.48	0.45	0.42	0.40	0.38	0.36	0.34	0.33	0.31	0.30
38.00	0.95	0.84	0.76	0.69	0.63	0.58	0.54	0.51	0.48	0.45	0.42	0.40	0.38	0.36	0.35	0.33	0.32
40.00	1.00	0.89	0.80	0.73	0.67	0.62	0.57	0.53	0.50	0.47	0.44	0.42	0.40	0.38	0.36	0.35	0.33
42.00	1.05	0.93	0.84	0.76	0.70	0.65	0.60	0.56	0.53	0.49	0.47	0.44	0.42	0.40	0.38	0.37	0.35
44.00	1.10	0.98	0.88	0.80	0.73	0.68	0.63	0.58	0.55	0.52	0.49	0.46	0.44	0.42	0.40	0.38	0.37
46.00	1.15	1.02	0.92	0.84	0.77	0.71	0.66	0.61	0.58	0.54	0.51	0.48	0.46	0.44	0.42	0.40	0.38
48.00	1.20	1.07	0.96	0.87	0.80	0.74	0.69	0.64	0.60	0.56	0.53	0.50	0.48	0.46	0.44	0.42	0.40
50.00	1.25	1.11	1.00	0.91	0.83	0.77	0.71	0.67	0.63	0.59	0.56	0.53	0.50	0.48	0.45	0.43	0.42
52.00	1.30	1.16	1.04	0.95	0.87	0.80	0.74	0.69	0.64	0.61	0.58	0.55	0.52	0.50	0.47	0.45	0.43

All figures rounded to nearest cent.

TM 2.2.4b

HYBRID CORN relative maturity comparison chart

Source: Northrup King: Hybrid Corn.

NORTHRUP KING	KE 408 KE 410 Wheatland	PX 414 PX 417 PX 418 PX 11 Wheatland	PX 420 PX 7 PX 14 Northern King Wheatland Silobred HSE	PX 442 PX 443 PX 19 Northern King Silobred HS 1	PX 446 PX 448 PX 22 Silobred HS 1	PX 15 PX 20 PX 466 PX 485 PX 26 Silobred HS 2	PX 32 PX 34 PX 37 KE 497 PX 504 PX 529 HS 2	PX 45 PX 46 PX 49 PX 545 PX 48 PX 50A PX 585 Silobred HS 3	PX 610 PX 610A PX 65 PX 614 PX 603 PX 606 PX 69	KT 626 PX 627 PX 616	PX 74 PX 79 PX 664 PX 675 PX 76 PX 87	PX 91 PX 715 PX 94 PX 95 PX 723 PX 737 PX 788 NK 1284 PX 99
DeKALB	[illegible]	XL 300	XL 311	XL 10 XL 309	XL 14A XL 304	XL 316A XL 12 XL 16 XL 310 XL 21A XL 19 XL 308A	XL 322 XL 321 XL 22 XL 25	XL 42 XL 43 XL 43A XL 343 XL [illegible] XL 41 XL 35	XL 44 XL 340 XL 45A XL 40 XL 54 XL [illegible] XL [illegible] 448	XL 62a XL 64 XL 66a XL 64b XL 394	XL 372 XL 70 XL 72AA XL 72b XL 75 XL 77 XL 81 XL 68 XL 75a XL 65b XL 383	XL 78 XL 66 XL 66a XL 380a XL 394 XL 395a XL [illegible] XL 85 XL [illegible] 1214 1285
PIONEER	3992	3990	3978 3980 3975a 3968 3867	3955 3965a	3903 3816 3967 3838 3965	3932A 3933 3901 3663	3785 3780B 3773	3780 3772 3764 3716 3710 3591 3596 3709	3541 3529 3498 3543 3570 3571 3517 3521 3518 3535 3588	3388 3395 3382 3424	3301A 3369A 3334A 3360 3330 3368	3147 3161 3179 3191 3151 3184
FUNK'S		G 4040	G 5040 G 4032	G 5100 G 5101	G 4141 G 4185	G 4252 G 4272 G [illegible]	G 4285 G 4322 G [illegible] G 4343 G 4321 G 4321a	G 4404 G 4444A G [illegible]	G [illegible] G [illegible] G 4445 G [illegible] G [illegible] G [illegible]	G [illegible] G [illegible] G [illegible] G [illegible]	G [illegible] G [illegible] G [illegible] G [illegible] G [illegible] G 4711	G 4737 G [illegible] G [illegible] G [illegible] G [illegible] G [illegible]

TM 2.2.5a

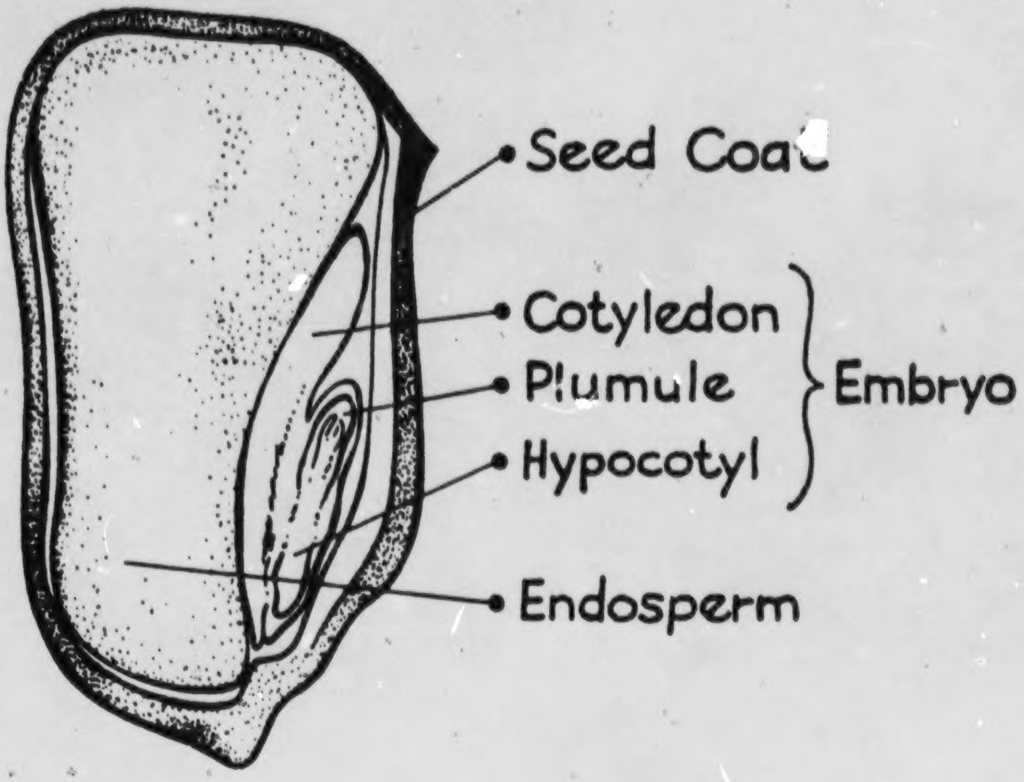
EXAMPLES OF FIGURING DAILY HEAT UNITS

$$\frac{\text{Maximum Daily Temperature} + \text{Minimum Daily Temperature}}{2} - 50 = \text{Heat Units}$$

$$\frac{82 + 64}{2} - 50 = 23 \text{ Heat Units}$$

$$\frac{86 + 50}{2} - 50 = 18 \text{ Heat Units}$$

STRUCTURE OF A CORN SEED (MONOCOTYLEDON)


Seed Coat
Cotyledon
Plumule
Hypocotyl
Embryo
Endosperm

VANTREESE, INST. MATL. LAB., U.K.

3. SEEDBED PREPARATION

3.1 Performance Objective

Given five different situations with various types of soil texture, drainage, and slope, the student will decide, with 80 percent accuracy as verified by the instructor, the most effective type of seedbed preparation to use.

3.2 Teaching-Learning Activities

a. This section on seedbed preparation can best be taught using the problem-solving procedure. Prepare appropriate problems for class use.

b. Take a field trip to a farm or demonstrate various tillage practices at the school. This may also be an opportunity for students to learn to operate a tractor and some equipment. Be sure to emphasize safety around equipment.

c. Have students observe tillage equipment while at the National Farm Machinery Show or visit a farm machinery dealership.

d. Use materials collected on tillage equipment as a source of information and as for student motivation.

e. One or more pieces of tillage equipment could be assembled for a dealer as a class project.

f. Use a farm machinery representative as a resource person to discuss types of tillage and cost of equipment.

g. Use extension personnel to discuss costs and advantages and disadvantages of various tillage methods.

h. Make and use transparencies and handouts from transparency masters.

3.2.1 Preparing a desirable seedbed for corn.

a. Several methods of seedbed preparation are now in use, from conventional tillage to no-till preparation. The method used should depend upon several factors--slope of land, soil texture and structure, drainage, previous crop grown, weed problems, insects and diseases infesting land, and machinery available.

The traditional and most widely used tillage system for corn consists of plowing with a moldboard plow in the fall or spring followed by one or more secondary tillage operations. However, the following questions should seriously be considered: "Is all of this tillage necessary?" "Is too much energy being used?"

"Is soil being lost through erosion on sloping lands?" In many fields, some form of reduced tillage should be considered.

There are only a few good reasons for plowing or heavily tilling a soil for corn: (1) a perennial weed problem that must be controlled by incorporated chemicals; (2) wet, clayey-type soils that will not allow air or water movement or do not warm up until very late in the spring, and (3) incorporation of residues, when necessary.

Minimum tillage should be used whenever possible to lessen compaction and erosion problems.

b. Fall plowing is practiced on many Kentucky farms to improve working ease of soil at planting, and to reduce overwintering of insects and diseases on plant residue. Fall plowing should be avoided wherever erosion is a problem.

c. Implements used in primary tillage (breaking up of the soil) are the moldboard plow, chisel plow, disk plow, ripper, and disk harrow. The chisel plow will leave more plant residue on the surface, thereby reducing erosion. The ripper is very beneficial in breaking up mechanical hardpans and compacted soils since its penetration is deep. It will also result in better penetration of water.

d. Implements used in secondary tillage (all soil preparation between primary tillage and planting) are disk harrow, field cultivator, rotary harrow, spike-tooth harrow, spring-tooth harrow, and other new tillage tools that combine parts of these others into one implement.

3.2.2 Identify the characteristics of a good seedbed.

Good seedbed preparation should include the following:

a. Break up compacted soil.

b. Cover plant residue that is infested with disease or insects.

c. Cut sod or trash that may hamper germination.

d. Break up clods.

e. Firm seedbed.

f. Smooth or level soil.

g. Kill weeds.

3.2.3 Recognize the opportunities of combining pest control, weed control, and fertilization application.

Several jobs in corn production can be carried out during soil preparation. Many chemicals used can be applied either in a liquid or as dry (granular) form. There is the possibility in no-tillage of performing all these operations in one pass over the field or at the most in two passes over the field. Combining operations has many advantages such as saving time and money. It may also contribute to higher yields by getting the crop planted on time and causing less compaction of the soil by fewer passes over the field.

a. Liquids are applied by either tank truck spreaders, aerial equipment, self-propelled sprayers, or tractor-mounted sprayers.

b. Dry chemicals are applied by either truck spreaders, aerial equipment, spreader wagon, fertilizer spreaders, or by fertilizer and insecticide boxes mounted on planter. These can be applied at the time of one of the secondary tillage operations.

3.2.4 Compare the relative advantage of minimum and conventional tillage systems.

a. The advantages of minimum-tillage system in corn production are: (See transparency masters 3.2.4a and 3.2.4b)

(1) Steeper land can be utilized for corn production.
(2) Better utilization of soil moisture with reduced runoff.
(3) Reduced machinery inventory.
(4) Reduced labor needs.
(5) Less erosion problem.
(6) Less soil damage from machinery.
(7) Reduction of some weather risks.
(8) Higher yields under drier conditions.
(9) Reduced double-cropping risks.
(10) Surface application of fertilizer and lime is as good in no-till as incorporated fertilizer in conventional tillage (as shown by research).

b. The advantages of conventional tillage system in corn production are:

(1) Control of weeds by burying seeds; however, it also turns some up.
(2) Destruction of excess surface trash or crop residue.
(3) Provides for breaking up and aeration of heavily-compacted soils.
(4) Reduction of insects and plant diseases that are found in plant residue. NOTE: A fall-seeded small grain will accomplish this in no-tillage.
(5) Better opportunity to correct mistakes made in control of weeds.

3.3 Supplementary Materials

References: 1. Modern Corn Production.

2. Producing Corn for Grain and Silage, AGR-79.

3. Producing Farm Crops.

Slides: "Tillage Systems for Corn."

Transparency Masters: 1. 3.2.4a, "Methods of Minimum Tillage."

2. 3.2.4b, "Yields of No-Tillage and Conventionally Planted Corn on Several Soils in Kentucky."

3.4 Check-Out Activities

Provide the students with five different situations with various types of soil texture, drainage, and slope, and have students decide what type of seedbed preparation to use.

METHODS OF MINIMUM TILLAGE

STRIP-TILL PLANTING.

STUBBLE MULCH PLANTING.

LISTER PLANTING.

CHISEL PLOW PLANTING.

FIELD-CULTIVATOR PLANTING.

DISK-PLANT.

NO-TILLAGE.

Yields of no-tillage and conventionally planted corn on several soils in Kentucky

Soil Type	No. of years tested	Yields (Bu/A) No-till	Yields (Bu/A) Conv
Maury silt loam	8	134	131
Crider	5	145	122
Tilsit silt loam	5	113	113
Allegheny silt loam	3	161	160
5 soils*	1	130	120

*Donerail, Granada, Loradale and Lowell silt loams, Faywood silty clay loam all compared in 1969.

Source: Producing Corn for Grain and Silage.

4. PLANTING METHODS AND PRACTICES

4.1 Performance Objective

Given a written check-out activity concerning planting methods and practices, the student will complete the check-out with 80 percent accuracy.

4.2 Teaching-Learning Activities

a. This section on planting methods and practices can best be taught using the problem-solving procedure. Prepare appropriate problems for class use.

b. Take a field trip to a farm to plant corn or plant corn on the school laboratory. You can practice calibrating a planter in the school parking lot.

c. Take a field trip to a farm machinery dealer to learn about new planting equipment.

d. Use transparency masters to make transparencies or handouts for students. If handouts are made, have students include them in their notebooks.

e. Take a field trip to observe test plots demonstrating various plant populations.

4.2.1 Calculate the actual seeding rate per acre based on desirable final plant population, and estimate mortality rate.

a. The normal population range for corn grown in Kentucky should be 16,000 to 24,000 plants per acre. Most hybrids are bred to perform satisfactorily in this range. Final corn stands below 16,000 plants per acre will not give as high yields for given conditions. When deciding on the final plant population needed, the following should be considered:

(1) Soil fertility.
(2) Planting date -- Earlier planted corn does not grow as tall as late planted corn; therefore, early corn may be planted 2,000 plants per acre thicker.
(3) Variety planted -- Some varieties are developed for higher population than other varieties.
(4) Land used -- Soils that are finer textured with good drainage can support higher population.
(5) Germination and viability of seed used -- Good seed will give 88 to 94 percent germination. Very early planting will cause a higher germination loss.

b. Size of seed used has been found to have little or no effect on germination nor yield. Results of seed size studies have recently been reported by the University of Minnesota and the University of Guelph in Ontario, Canana. Both studies agree that corn seed size has no practical effect on corn performance. The only measurable difference is that larger seed produces larger young plants in some cases. This plant size difference was overcome by later growth, however. The conclusion has to be that farmers choose their corn hybrids on the basis of expected performance, never on seed size availability.

4.2.2 Describe the effect of planting date, planting depth, plant population, and row width on yield. Information taken from Producing Corn for Grain Silage.

a. Date of Planting -- In recent years a decided trend has been toward earlier planting. Earlier planted corn has outyielded late planted corn and has had fewer insect and disease problems. In order to reduce yield losses, it is important to finish planting corn before May 10 in western Kentucky and May 20 in eastern Kentucky. As shown from several planting date studies in Kentucky conducted over several years, a one percent per day yield loss (one bushel per day on a 100 bushel yield) can be expected when planting is delayed past May 15 (see transparency master 4.2.2a). How early you start depends on soil conditions, acres to be planted and work days available. A good guide for earlier starting time is to watch for the soil temperature to rise above 50°F for several days. Soil does not warm up as rapidly for no-tillage planting as it does for tilled soil. Where planting is delayed past June 1, hybrids classified earlier than "full-season" should be used, especially in central and eastern Kentucky.

b. Planting Depth -- Ideal planting depth depends on soil and weather conditions. For average conditions, a 1½ - 2-inch depth is ideal. For early planting, especially when the soil is cool and wet, the ideal depth may be slightly less. When the surface soil is dry, as is sometimes the case when planting is delayed, you may have to plant 3 inches or slightly deeper to get the seed to moisture. Depth is particularly critical in no-tillage planting. Careful control of planting depth will not only improve stand levels but will also mean more uniform emergence. Corn planted too deep simply does not come up.

c. Plant Population -- Poor or inadequate stands is still one of the most limiting factors in producing top yields. In recent research studies at the University of Kentucky, slightly higher plant populations for no-tillage planted corn yielded more, with less incidence of lodging, as compared to conventional planted corn (see transparency master 4.2.2b). In two out of five years, lodging was sharply higher at plant populations above 20,000 per acre. The recommended planting rates for consistent top yields are as follows:

Conventional - 18-22,000 kernels/acre
No-tillage - 20-26,000 kernels/acre
Silage - 20-28,000 kernels/acre

For planting at the upper range of these recommendations, such factors as adequate soil moisture, a high yield goal, high productive soil, high fertility and top management should exist. See transparency master 4.2.2c which presents a corn planting guide for various row widths and expected final stands. If your final stand is less than 16,000 plants per acre, top yields cannot be expected. When planting very early or using an early maturing hybrid, you can plant up to 2,000 more kernels per acre because of more seedling mortality, shorter plants with less lodging and more adequate moisture supply expected.

d. Row Width -- Rows narrower than 36 inches have not shown a yield advantage in Kentucky. A 5-year research study (1972-76) comparing row widths of 38, 36, 30 and 18 inches on a Crider silt loam soil showed no differences between row widths for corn grain yields (see transparency master 4.2.2b).

The 36- or 38-inch row width gives optimum yield and allows for easier machine operation and emergency weed control measures. Also, a 36- or 38-inch row is most practical in Kentucky since the planter can be converted to a row width of 18 or 19 inches for planting double-cropped soybeans by simply adding additional units.

4.2.3 Plant corn.

a. Before planting corn, the corn planter should be thoroughly inspected for broken, worn, or bent parts. Even and accurate drop is essential for good corn yields. Calibrate the planter to be sure you are getting the correct seed drop for the planter speed you plan to use (see transparency masters 4.2.3a and 4.2.3b).

b. Planter speed is important in getting the desired rate of seed drop, especially with plate-type planters. The faster rate of travel will reduce the rate of seed drop with most corn planters. Plateless planters may be driven at higher speeds, but speed is still important. See operator's manual for these planters.

On plate-type planters, speed must be slow enough to allow each cell in the seed plant to receive and discharge a kernel every revolution. The maximum speed that a cell in an edge-drop planter should move has been determined to be approximately 725 inches per minute. By formula, the maximum revolutions per minute for plates of various diameter can be determined (the larger the plate diameter, the lower the maximum revolutions per minute).

From this, a formula for determining maximum planting speed in miles per hour can be developed. You need to know plate diameter, number of seed cells, and desired seed spacing (in inches) in the row. For various plates, multiply the factor shown below by the desired seed spacing in inches to determine maximum travel speed in miles per hour.

Plate Diameter	No. Seed Cells	Factor
6 inch	16	0.576
6 inch	24	0.864
7 inch	16	0.496
7 inch	24	0.744
8 inch	16	0.432
8 inch	24	0.648
9 inch	16	0.384
9 inch	24	0.576
10 inch	16	0.352
10 inch	24	0.528

For example, using 7-inch 16-cell plates, a planter in perfect operating condition set to drop one kernel every 10 inches should be operated at a maximum forward speed of 4.96 miles per hour (MPH) (0.496 x 10 = 4.96). A 24-cell plate of the same diameter would permit ground speed of 7.44 MPH (0.744 x 10 = 7.44).

The above can be used for any plate size. For convenience, a general rule for determining maximum planting speed in MPH with Deere and International planters is as follows:

Deere 16-cell plate:	Seed spacing x 0.5 = maximum MPH
Deere 24-cell plate:	Seed spacing x 0.7 = maximum MPH
International 16-cell plate:	Seed spacing x 0.43 = maximum MPH
International 24-cell plate:	Seed spacing x 0.65 = maximum MPH

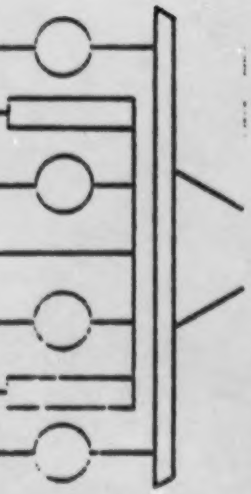
As an example, a Deere planter with 24-cell plates set to drop a kernel every 8 inches can be operated up to 5.6 MPH (0.7 x 8); an International with 24-cell plates should not travel more than 5.0 MPH (0.65 x 8). Note that as planting rate increases (and kernel spacing decreases), maximum planting speed decreases.

c. Determining Field Speed. In planting corn, it is important to know how fast you are driving, especially if you are applying granular or liquid chemicals at the same time. You can determine your field speed as follows:

(1) Carefully mark off a distance of 176 feet in the field.
(2) As you plant, check the number of seconds required to drive between the markers with a stop watch or a watch with a sweep second hand.
(3) Divide the time in seconds into 120 for speed in miles per hour.

The chart below lists the time in seconds for speeds up to 7 miles per hour:

TIME TO DRIVE 176 FEET	SPEED
120 seconds	1 mile per hour
60 seconds	2 miles per hour
40 seconds	3 miles per hour
30 seconds	4 miles per hour
24 seconds	5 miles per hour
20 seconds	6 miles per hour
17 seconds	7 miles per hour



d. Planter problems and their causes:

Problems When Planter Plants Too Little Seed

(1) Weak knocker spring
(2) Wrong size tires on drive wheel
(3) Too much air in tires
(4) Wrong size seed plate (check plate suggestions on bag); worn seed plate
(5) Wrong planter setting

Problems When Planter Plants Too Much Seed

(1) Weak cut-off tongue spring
(2) Worn cut-off tongue
(3) Worn floor plate
(4) Warped floor plate
(5) Warped seed plate; worn seed plate
(6) Wrong drive sprocket
(7) Groove on floor plate is turned up when it should be down

Problems When a Planter Plants Unevenly

(1) Chain loose
(2) Chain on wrong sprocket
(3) Dirty or worn out clutch
(4) Wrong seed plate; worn seed plate
(5) Seed plate upside down
(6) Groove side of floor plate turned wrong side up

(7) Planter out of time
(8) No oil in gear case
(9) Kernel inside cut-off cap stopping knocker and cut-off action; cut-off tongue stuck in "up" position
(10) Uneven tire pressure
(11) Wheel slippage in an extremely soft or a cloddy seed bed
(12) Planter operated too fast for plate accuracy. Small seeds must be planted at slower field speeds than larger seed sizes. Planter speed must be reduced as seeds per acre increase.

Problems When a Planter Strings Seed

(1) Too much trash in field (use trash kickers)
(2) Driving too fast
(3) Shoe clogged with mud
(4) Planter shoe worn out
(5) Hitch level too high or too low
(6) Wrong floor plate or floor plate groove in wrong position

Problems When a Planter Cracks Seed

(1) Wrong size plates (check plate suggestion on seed bag)
(2) Worn cut-off tongue
(3) Seed plates have manufacturer's burrs in cells
(4) Wrong floor plate
(5) Kernel does not drop down even with top of plate (check floor plate and groove)
(6) Sharp edges on cut-off tongue and cell edges
(7) Burr on floor plate

Problems When a Planter Won't Go Into the Ground

(1) Worn planter shoes
(2) Disk furrow openers too far down
(3) Hitch level too high or too low
(4) Wrong adjustment on press wheels
(5) Wrong stroke on hydraulic cylinder
(6) Wrong size tires (too big)

Testing Planter

(1) Test run planter
(2) Re-check daily
(3) Watch seed box levels for uneven seeding

4.2.4 Identify types of planting equipment.

a. Almost all corn planted in Kentucky is done by seed drill (corn and soybean type) with the seed drop in the drill row rather than hill-drop or check planting.

b. Many new planters on the market at the present do not use plates to determine seed drop (plateless planters). Some of these plateless planters use air to determine the drop of the seed.

c. Selection of planting equipment will depend on its uses (corn, soybeans, grain sorghum) intent, ability to change row widths, and if it's to be used for no-till and/or conventional planting. Items important to consider in types of planters are: the initial soil penetration (smooth coulter, fluted coulter, sweep, ripple coulter, or rotary tiller), depth control (depth bands for double-disk opener or gauge wheels), furrow opening and seed placement (double-disk opener, shoe-type opener, or chisel-boot opener), seed imbedding (seed press wheel, seed press wheel with disk cover, or disk coverer), and furrow closure (rear press wheel or rear press wheel with seed firming rib) (see transparency masters 4.2.4a and 4.2.4b).

4.2.5 Calendarize the corn acreage.

a. "Calendarization" is planting part of the crop in early variety (ies), about 10 percent, part in mid-season variety(ies), about 20 percent, and part in full season variety(ies), about 70 percent--starting with the early first, then the full season, and finishing with the mid-season.

b. Calendarization planting spreads out time of harvest over the optimum period; reduces risk of entire crop being damaged by drought, insects, or disease; and gives more time to plant small grains, harvest early soybeans, or do fall plowing.

4.3 Supplementary Materials

References: 1. Crop Production.

2. Modern Corn Production.

3. Producing Corn for Grain and Silage, AGR-79.

Transparency Masters: 1. 4.2.2a, "Effect of Planting Date on Corn Yields."

2. 4.2.2b, "Effect of Plant Population and Row Width on No-Till and Conventionally-Planted Corn Yields and Lodging."

3. 4.2.2c, "Corn Population Planting Guide."

4. 4.2.3a, "Corn Planting Speed and Its Effect on Seed Drop."

5. 4.2.3b, "Calibrating Kernel Drop."

6. 4.2.4a, "Tool Options for No-Tillage Planter Functions."

7. 4.2.4b, "Tool Options for No-Tillage Planter Functions (Continued)."

4.4 Check-Out Activities

1. The normal population range for corn grown in Kentucky is 20,000 to 26,000 plants per acre. T F

2. Good seed will give 88 to 94 percent germination. T F

3. In order to reduce yield losses, it is important to finish planting corn by May 10 in western Kentucky and May 20 in eastern Kentucky. T F

4. Poor or inadequate stands is still one of the most limiting factors in producing top yields. T F

5. The 40- or 42-inch row width is the most practical in Kentucky. T F

6. A big advantage of a plate-type planter is that you can plant as fast as it is safe to drive the tractor. T F

7. Before planting corn, the corn planter should be thoroughly inspected. T F

8. If you have less than 16,000 plants per acre, top yield cannot be expected. T F

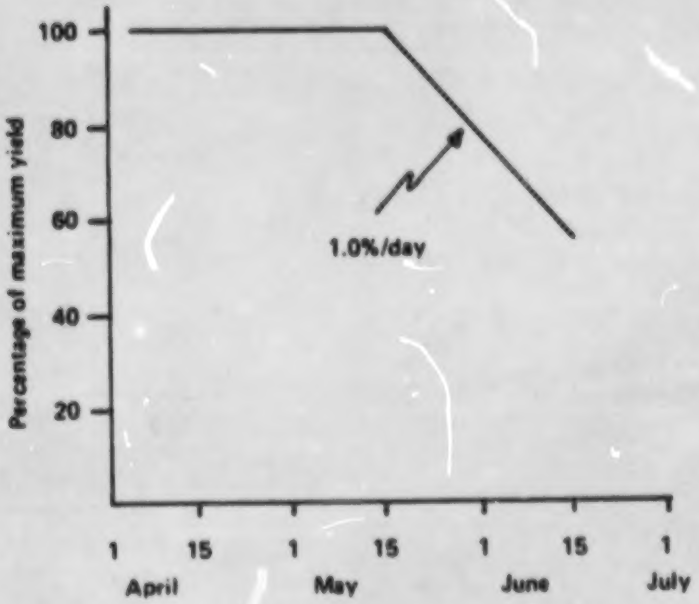
9. What is the desirable depth for planting corn? __________

10. Planting depth should depend on __________ and __________.

ANSWERS:

1. False
2. True
3. True
4. True
5. False
6. False
7. True
8. True
9. 1½ to 2 inches
10. a. Moisture
    b. Soil temperature

Effect of planting date on corn yields.



Source: Producing Corn for Grain and Silage.

Effect of plant population and row width on no-till and conventionally planted corn yields and lodging[1]

	Yields (Bu/A)		% Lodging	
	No-till	Conv	No-till	Conv.
Plants/Acre	1972-74	1973-74	1973	
14,000	142 a[2]	126 a	3.4 a	7.5 a
20,000	166 b	134 b	9.6 a	31.2 b
26,000	177 c	146 c	22.8 b	39.9 b
	1975-76		1975	
18,000	119 a	102 a	21.0 a	13.0 a
23,000	121 ab	104 ab	25.0 a	14.0 a
28,000	127 b	111 b	21.0 a	20.0 b
Row Width	1972-74	1973-74	1973	
18 in	161 a	138 a	10.5 a	22.3 a
36 in	162 a	133 a	13.3 a	30.1 b
	1975-76		1975	
30 in	117 a	–	31.0 b	–
38 in	123 a	106	22.3 a	15.7

[1] 5 year study in Hardin County on a Crider silt loam soil.

[2] Values followed by the same letter within a given date and tillage method do not differ significantly at the 5 percent level.

Source: Producing Corn for Grain and Silage.

Corn population planting guide.

Harvest population of [1]	Requires planting rate of	Inches Between Kernels When Planting at Various Row Widths				
		20"	30"	36"	38"	40"
14,400	16,000	19.6	13.2	10.9	10.4	9.8
15,300	17,000	18.4	12.4	10.2	9.8	9.2
16,200	18,000	17.4	11.7	9.7	9.2	8.7
17,100	19,000	16.5	11.1	9.2	8.7	8.2
18,000	20,000	15.7	10.5	8.7	8.3	7.8
19,800	22,000	14.3	9.5	7.9	7.5	7.1
21,600	24,000	13.1	8.7	7.2	6.9	6.5
23,500	26,000	12.1	8.1	6.7	6.4	6.0
25,200	28,000	11.2	7.5	6.2	5.9	5.6

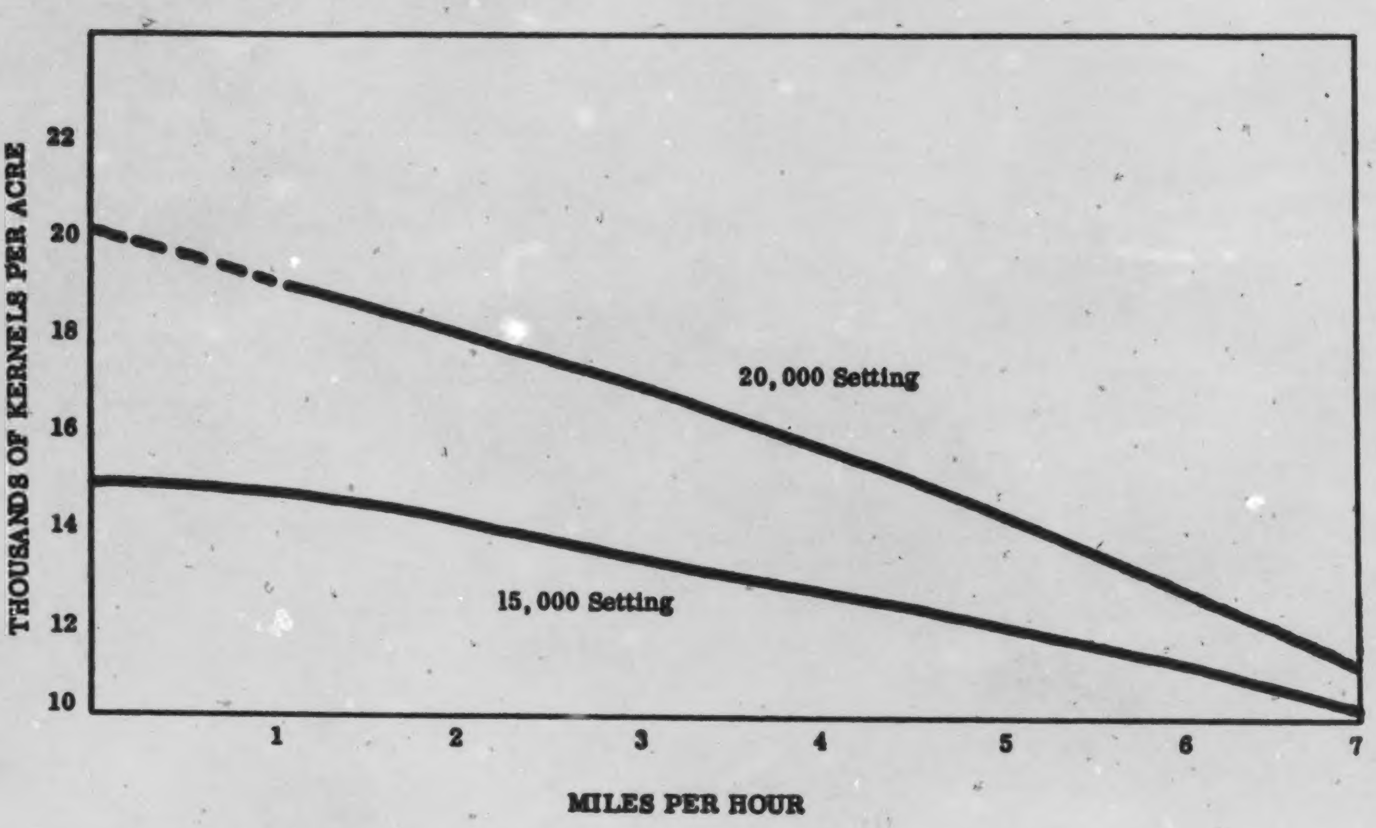
[1] Allows 10 percent stand loss.

Source: *Producing Corn for Grain and Silage*.

CORN PLANTING SPEED AND ITS EFFECT ON SEED DROP

Planter setting: 15,000 and 20,000 seed drop

Seed plate: $\frac{36}{64}$" length seed cell



TM 4.2.3a

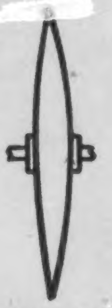
SOURCE: Rate of Planting Corn.

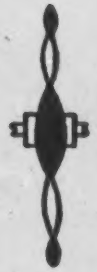
CALIBRATING KERNEL DROP

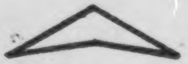
1. Check planter parts -- replace worn parts and clean all parts.
2. Select proper plant population.
3. Read the operators manual.
4. Match corn seed grade to plate size.
5. Adjust planter for desired planting rate.
6. Check seed drop on clean, flat surface.
   - Stake out distance
   - Drive at planting speed
   - Count kernels from back row
7. Make a field check (dig into row).
8. Count emerged plants and plants ar harvest time.

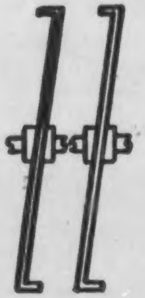
TOOL OPTIONS FOR NO-TILLAGE PLANTER FUNCTIONS

FUNCTION: INITIAL PENETRATION

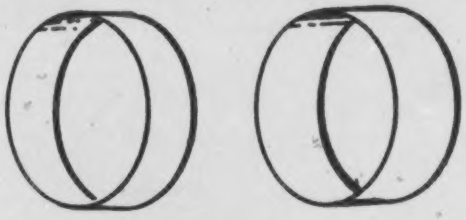

SMOOTH COULTER

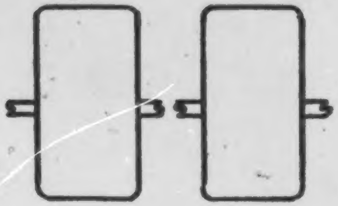

FLUTED COULTER


SWEEP


ROTARY TILLER

FUNCTION: DEPTH CONTROL

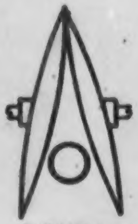

DEPTH BANDS FOR DOUBLE-DISK OPENER


GAUGE WHEELS

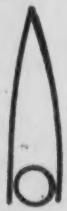
TM 4.2.4a

TOOL OPTIONS FOR NO-TILLAGE PLANTER FUNCTIONS (CONTINUED)

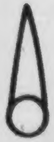
FUNCTION:
FURROW OPENING
&
SEED PLACEMENT



DOUBLE-
DISK OPENER

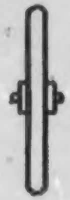


SHOE-TYPE
OPENER
(with seed tubes)

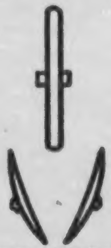


CHISEL-BOOT
OPENER

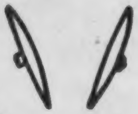
FUNCTION:
SEED IMBEDDING



SEED PRESS
WHEEL

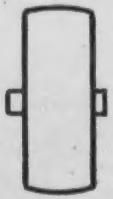


PRESS SEED WHEEL
WITH DISK COVERER

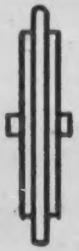


DISK COVERER

FUNCTION:
FURROW CLOSURE



REAR PRESS WHEEL



REAR PRESS WHEEL WITH
SEED FIRMING RIB

5. FERTILIZER RATES AND APPLICATION

5.1 Performance Objective

Given a written check-out activity concerning fertilizer rates and application, student will complete the activity with 80 percent accuracy.

5.2 Teaching-Learning Activities

a. This section on fertilizer rates and application can best be taught using the problem-solving procedure. Prepare appropriate problems for class use.

b. If the class you are teaching has not completed a lesson on soil testing or if they need a review, use a competency-based vocational education module NP-1 or GG-1, "Taking Soil Samples"; or use the Section 4 on soil testing in the Tobacco Production unit in this series.

c. Take field trips to:

   (1) take a soil sample
   (2) visit a soil testing laboratory
   (3) visit a fertilizer plant
   (4) test plots to view the effect of various fertilizer applications

d. Establish a fertilization demonstration plot near the school.

e. Make and use transparencies or handouts from the transparency masters.

f. Obtain fertilizers to show students samples of different kinds.

g. Obtain the latest extension bulletins of fertilizer recommendations.

5.2.1 Determine fertilization rates required for maximum yield or maximum return per fertilizer dollar.

a. The best method of determining the fertilization rates needed for maximum returns on the fertilizer dollar is by soil testing. The most common soil test provides information regarding pH, P, and K. More comprehensive tests may be obtained that provide information regarding total exchange capacity (T.E.C.) of the soil, soil organic matter content, percent of base saturation, major nutrients, secondary nutrients, pH, and trace nutrients. All the information obtained from soil test reports should be used along with the cropping program, the ability of the soil to supply moisture, and the erosion hazards of the land in planning the fertilization program.

b. The major nutrients--nitrogen (N), phosphorus (P), and potassium (K)--must be supplied to corn in the greatest amounts. Corn is a heavy user of N; roughly 1.5 pounds per bushel of yield is found in the stover and grain. Phosphorus content in the soil and corn plant is low compared to N and K. Very little of P in the soil is available to the corn crop on a given day; less than 1 pound per acre is in the soil solution to be absorbed. For each bushel yield of corn, about 0.6 pound of P is found in the stover and grain. Potassium is required in large amounts by corn. Usually about 1.3 pounds per bushel of yield is found in the stover and grain. All soils except sand have large amounts of K, but only about 1 to 2 percent becomes available annually. For up-to-date fertilizer and lime recommendations for corn, see the latest (published yearly) Lime and Fertilizer Recommendations, AGR-1.

c. The secondary elements--calcium (Ca), magnesium (Mg), and sulfur (S)--are used in lesser amounts than the three major elements. The amount of these secondary elements needed per bushel of yield for the stover and grain are: Ca-0.22 pound, Mg-0.22 pound, and S-0.17 pound. Trace or micronutrients--manganese (Mn), copper (Cu), zinc (Zn), and boron (B)--are occasionally deficient in corn, but only Zn is likely to be short. Zinc will most likely show up as a deficiency when soil has a high pH and P test. For best balance of secondary and trace elements, maintain a pH of 6.0 to 7.0 (see transparency masters 5.2.1a, 5.2.1b, 5.2.1c, and 5.2.1d).

5.2.2 Recognize the effect of nutrient levels and fertilizer placement on yield and quality of corn.

(See transparency masters 5.2.2a and 5.2.2b.)

a. Nitrogen is used by the corn plant early in its life for growth, sturdy stalks, wide leaves with large photosynthesis surface, and later for production of high protein grain (see transparency master 5.2.2c). Nitrogen moves freely in the soil so a plant is able to obtain N easily when it is made available in the soil.

b. Phosphorus needs of corn are most critical in the early part of the plant's life. If a P deficiency is going to show in corn, it will appear before the plant is 24 inches tall. P moves only about 1 to 1½ inches from its point of placement, so it is necessary to get P applied in the area of soil where the plant's roots can reach it quickly (see transparency master 5.2.2d).

c. Potassium is needed by the corn plant for vigorous growth, stalk strength, root development, and grain production. The K needs of a corn plant are the greatest from the time the plant is one foot tall until just before tassels emerge. K moves in the soil much less than N but more than P (see transparency master 5.2.2d).

d. On soils that test medium to high in the three major nutrients, the fertilizer may be broadcast. On soils testing low in these nutrients, part of the fertilizer should be banded beside the row for nutrients to be readily available and to avoid damaging the young seedling. (Damage can occur if the fertilizer is in direct contact with the seed.) In no-tillage, all nutrients can be applied on the surface and still obtain top results.

5.2.3 Identify nutrient deficiency symptoms in corn.

The following nutrient deficiencies have these symptoms:

a. Nitrogen - the plant shows a pale yellowish color early. Later a v-shaped burn appears low on tips of blades on the lower portion of the plant.

b. Phosphorus - will nearly always appear as a purple coloring and stunted appearance in plants before they reach 24 inches tall.

c. Potassium - appears as burns on leaf margins of lower leaves anytime from when corn is about a foot tall until before tassels emerge. The internodes will turn brown.

d. Magnesium - in young corn plants, looks much like zinc deficiencies. As the plants grow older, the white streaks become more prominent and a purple cast appears on the underside of the leaf.

e. Zinc - shows up in light-colored buds, with an almost bronze-colored cast. Severe deficiency is indicated by wide white-colored streaks in upper leaves. The internodes will turn purple.

f. Manganese - thin, white streaks appear on most leaves. Manganese toxicity (too much) is a greater problem than deficiency. Toxicity occurs at a very low pH.

g. Copper - young (upper) corn leaves lose their color; the leaf edges and tips then start to die.

5.2.4 Develop a farm fertilization program for corn.

More of the corn is now grown in a crop rotation with wheat or barley and soybeans. Corn grown following a grass-legume sod will need 50 to 75 pounds less N. Most farmers have their P and K levels at medium or high levels. At these levels, only a maintenance application of P and K is necessary (0-60 pounds P_2O_5 and 0-60 pounds K_2O). At high levels of P and K, no fertilizer application for one or two years for grain production is necessary.

5.2.5 Describe the different methods of fertilizer application for corn.

Fertilizer may be applied by broadcasting, banding beside the row, pop-up (placement in the row--this is not recommended in Kentucky), sidedressing, and injecting into the soil (anhydrous ammonia). Fall application of P and K, plowed down, works well in Kentucky. Fall N application is not feasible because of Kentucky's rainfall and warm temperatures during the winter. Denitrification (changing nitrates into nitrogen gases N_2O and N_2 which escape into the air) takes place fast when soil temperatures are above 50°F. Most N used by corn must be converted to the nitrate form by nitrification (breaking down urea, manure, plant residue, and anhydrous ammonia into nitrate form) during the growing season.

a. Broadcasting of N, P, and K is recommended for land which you own or lease for a long time and which has a high fertility level.

b. Row application of part of the fertilizer is recommended on rented land or land that is low in fertility.

   (1) Row application has advantages--faster early growth, more uniform growth on low fertility land or wet cool soils, and may hasten maturity.
   (2) In row application, keep N and K 1½ to 2 inches away from seed to reduce danger of germination damage.
   (3) For row applications, use 5-10 pounds N, 18-27 pounds P_2O_5, and 12-24 pounds K_2O per acre.

c. Pop-up (placing fertilizer with seed) is not recommended in Kentucky.

d. Sidedressing is the application of N before the corn gets knee-high. It gives a little higher yield and allows you to gauge N needed to plant population. It takes an extra pass over the field.

e. Injecting anhydrous ammonia is necessary since it is a gas and will escape if not injected. Since anhydrous ammonia is usually less expensive than other forms of N, it may be worth the expense and effort to inject it, depending on relative cost. Other forms of N, including granules, may need to be incorporated into the soil to prevent their escape.

5.3 Supplementary Materials

References:
1. Farm Manure: Production, Value, Use, ID-19.
2. Gardening - Groundskeeping, GG-1, "Taking Soil Samples."
3. How To Take Good Soil Test Samples, AGR-16.
4. Liming Acid Soils, AGR-19.
5. Modern Corn Production.

6. Nitrogen in Kentucky Soils: Sources, Reactions, and Fertilization, AGR-43.

7. Nursery Production, NP-1, "Taking Soil Samples."

8. Tobacco Production, Unit in this series.

9. Urea as a Source of Fertilizer Nitrogen for Crops in Kentucky, AGR-69.

10. When to Apply Lime and Fertilizer, AGR-5.

11. 1979 Lime and Fertilizer Recommendations, AGR-1.

Movies:
1. "A Little Better Timing."
2. "Positive Placement of Fertilizer."
3. "Primer for Professionals."

Transparency Masters:
1. 5.2.1a, "Elements Essential for Plant Growth."
2. 5.2.1b, "Pounds of Selected Plant Nutrients Contained in Crops."
3. 5.2.1c, "Proportion of Nutrients in Corn Grain and Stover."
4. 5.2.1d, "Soil Acidity Affects the Availability of Most Nutrient Elements."
5. 5.2.2a, "Role of Nutrients in Plant Growth."
6. 5.2.2b, "Plant Food Taken Up By Corn."
7. 5.2.2c, "Nitrogen in the Life of the Corn Plant."
8. 5.2.2d, "Phosphorus in the Life of the Corn Plant."
9. 5.2.2e, "Potassium in the Life of the Corn Plant."

5.4 Check-Out Activities

1. The best method for determining fertilizer needs is by soil testing. T F

2. The most common soil test provides information regarding pH, phosphorus, and potassium. T F

3. What are the three major nutrients? ________, ________, ________

4. How much nitrogen is needed for each bushel of corn produced? ________

5. Name the three secondary nutrients. _______, _______, _______

6. Fall application of phosphorus and potassium works well in Kentucky. T F

7. Fall application of nitrogen works well in Kentucky. T F

8. There is never enough P and K in the soils and a small amount should be added even in high P and K soils. T F

9. If a P deficiency is going to show in corn, it will appear before the plant is 24 inches tall. T F

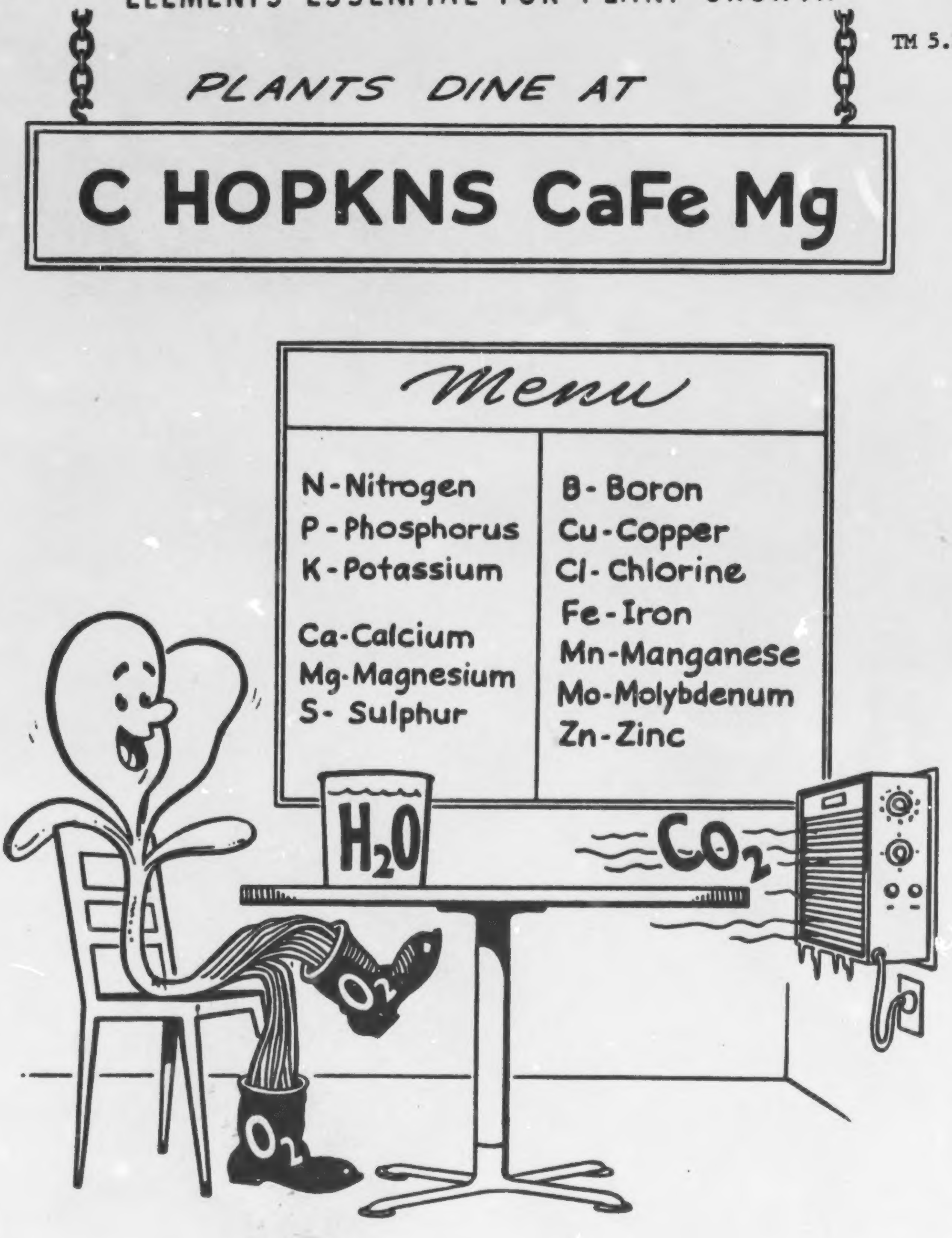
10. The need for K is greatest between germination and when the plant reaches one foot of height. T F

ANSWERS:

1. True
2. True
3. a. Nitrogen
   b. Phosphorus
   c. Potassium
4. 1.5 pounds
5. a. Calcium
   b. Magnesium
   c. Sulfur
6. True
7. False
8. False
9. True
10. False

ELEMENTS ESSENTIAL FOR PLANT GROWTH

TM 5.2.1a


PLANTS DINE AT
C HOPKNS CaFe Mg
Menu
N-Nitrogen
P-Phosphorus
K-Potassium
Ca-Calcium
Mg-Magnesium
S- Sulphur
B-Boron
Cu-Copper
Cl-Chlorine
Fe-Iron
Mn-Manganese
Mo-Molybdenum
Zn-Zinc
H2O
CO2
O2
O2

T. VANTREESE, INSTR. MATL. LAB, U.K.

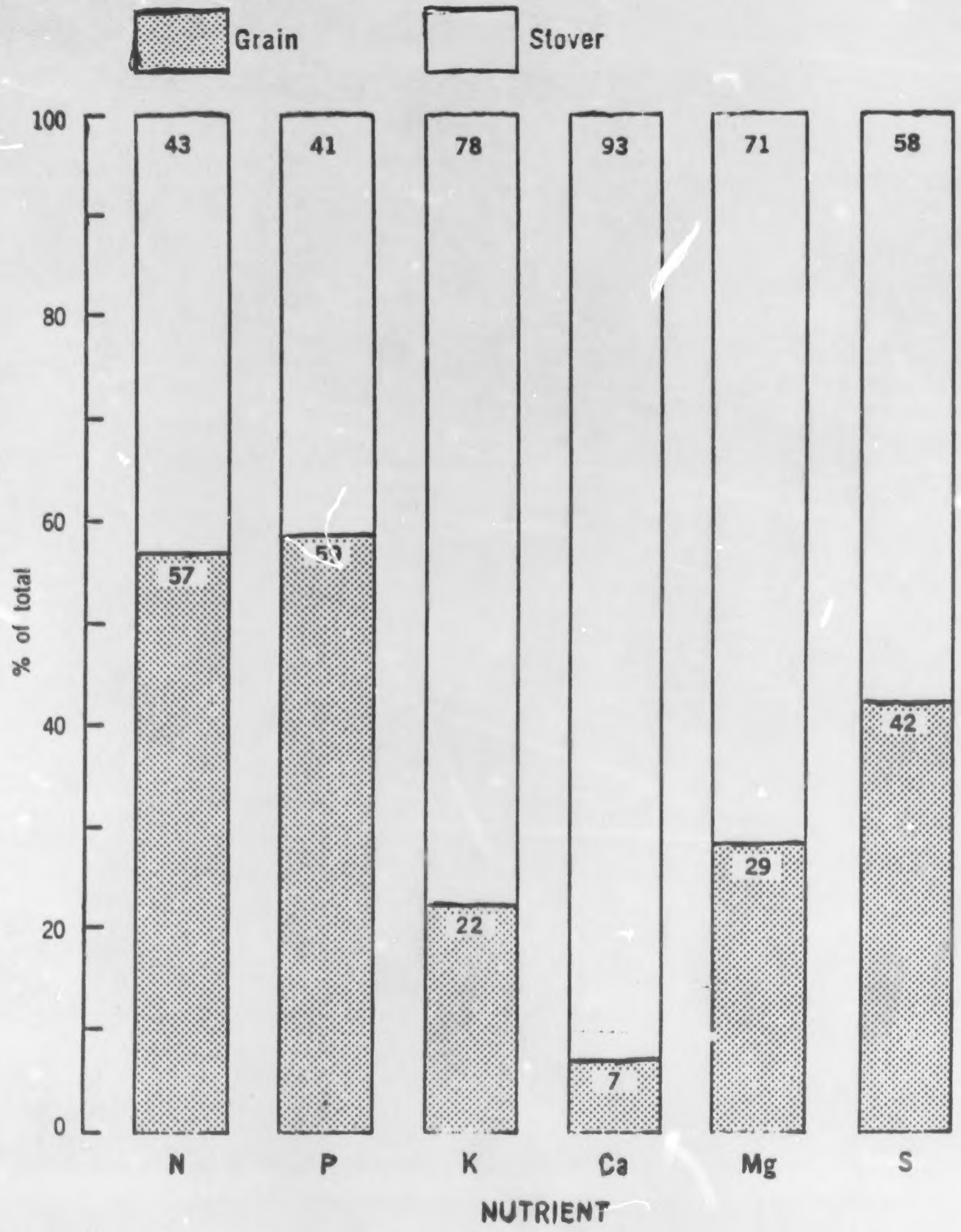
POUNDS OF SELECTED PLANT NUTRIENTS CONTAINED IN CROPS

CROP	NUTRIENT										
	N	P_2O_5	P	K_2O	K	Ca	Mg	S	Cu	Mn	Zn
Corn, 100 bu.											
grain	90	36	16	26	22	11	13	10	.04	.06	.10
stover	67	24	11	98	80	18	12	7	.03	1.00	.20
Total	157	60	27	124	102	29	25	17	.07	1.06	.30

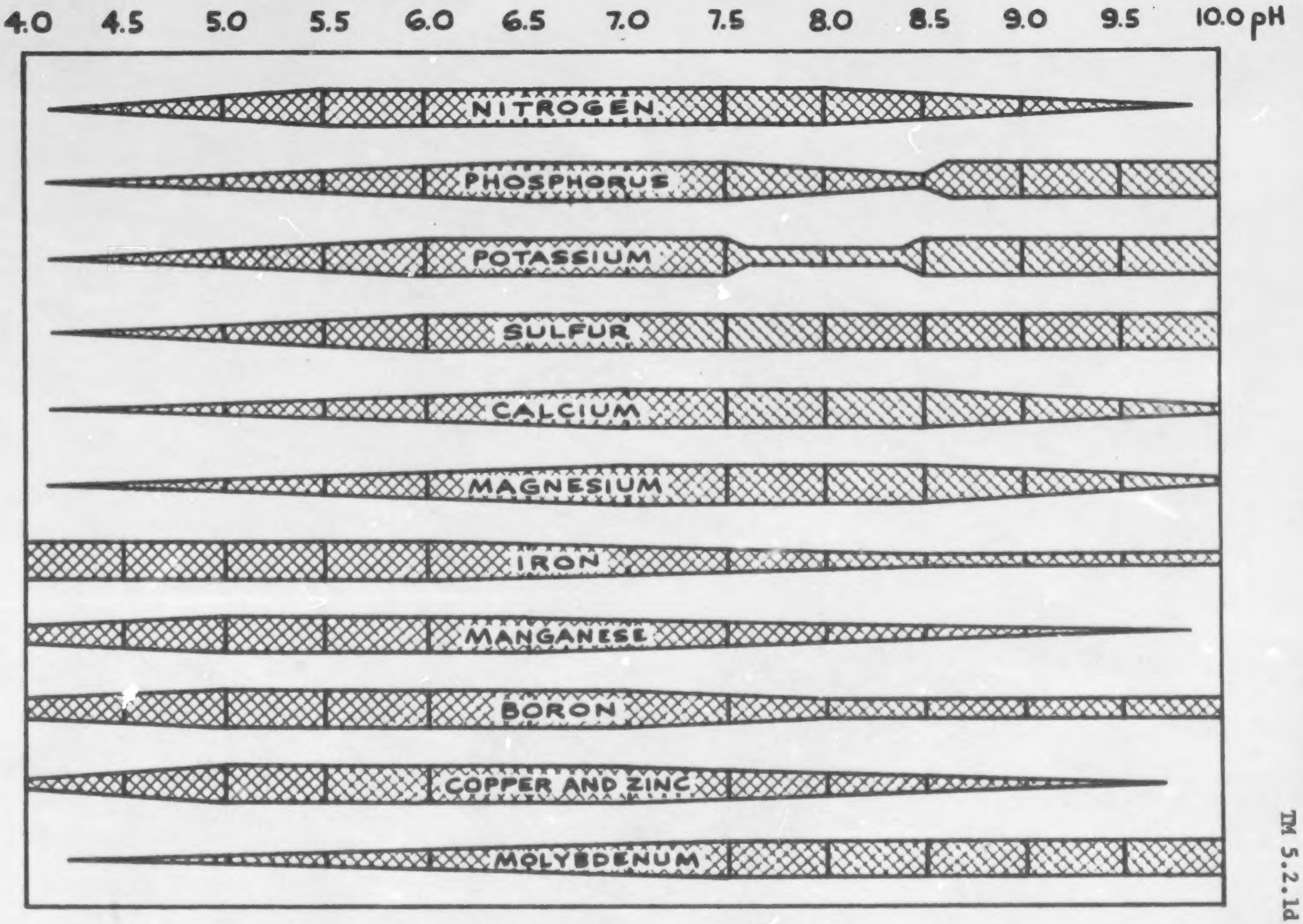
Source: Our Land and Its Care.

Proportion of Nutrients in Corn Grain and Stover

(Leaves, stalk, cob)

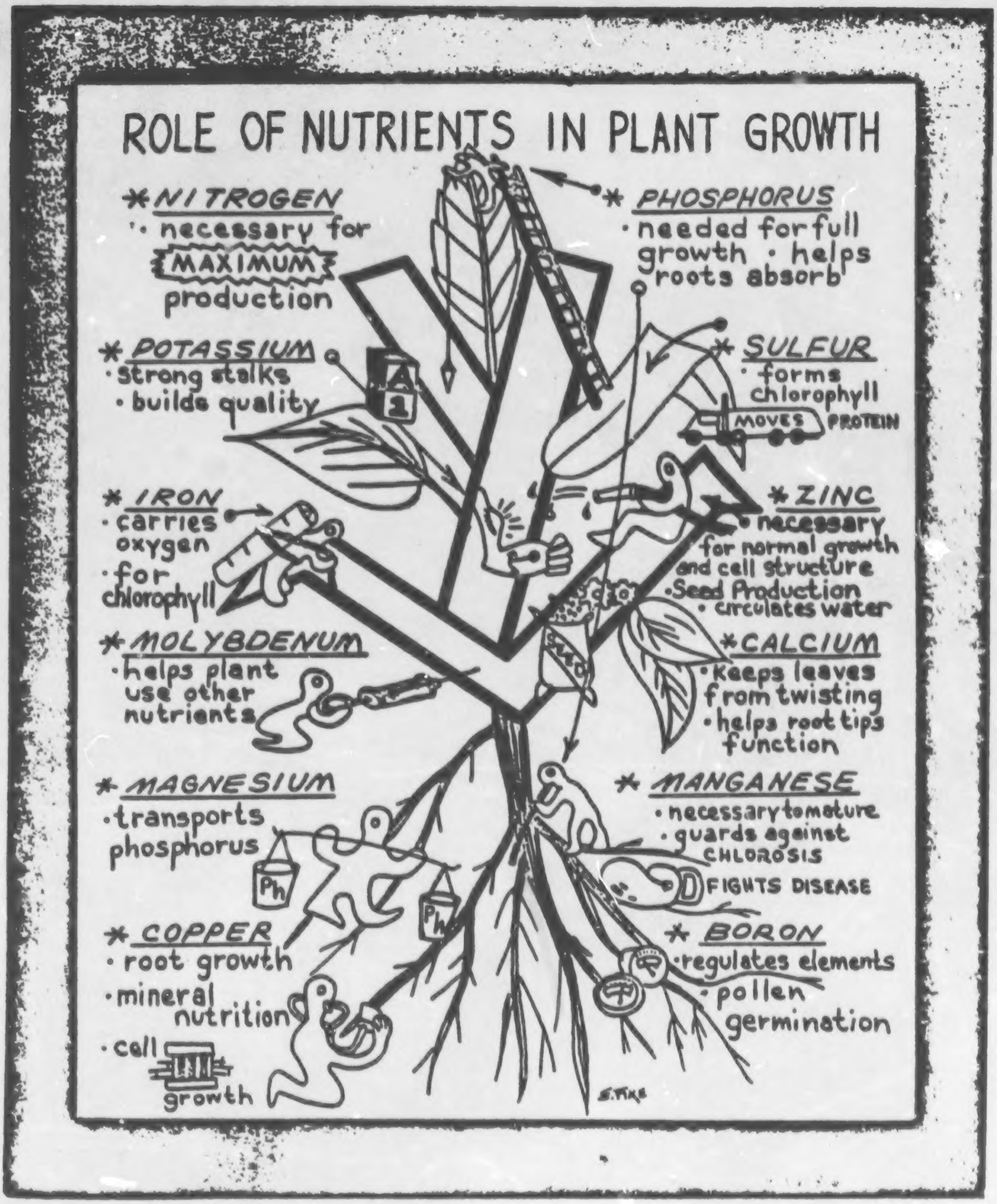


T. VANTREESE, INST. NATL. LAB. U.K.



SOIL ACIDITY AFFECTS THE AVAILABILITY
OF MOST NUTRIENT ELEMENTS

TM 5.2.1d

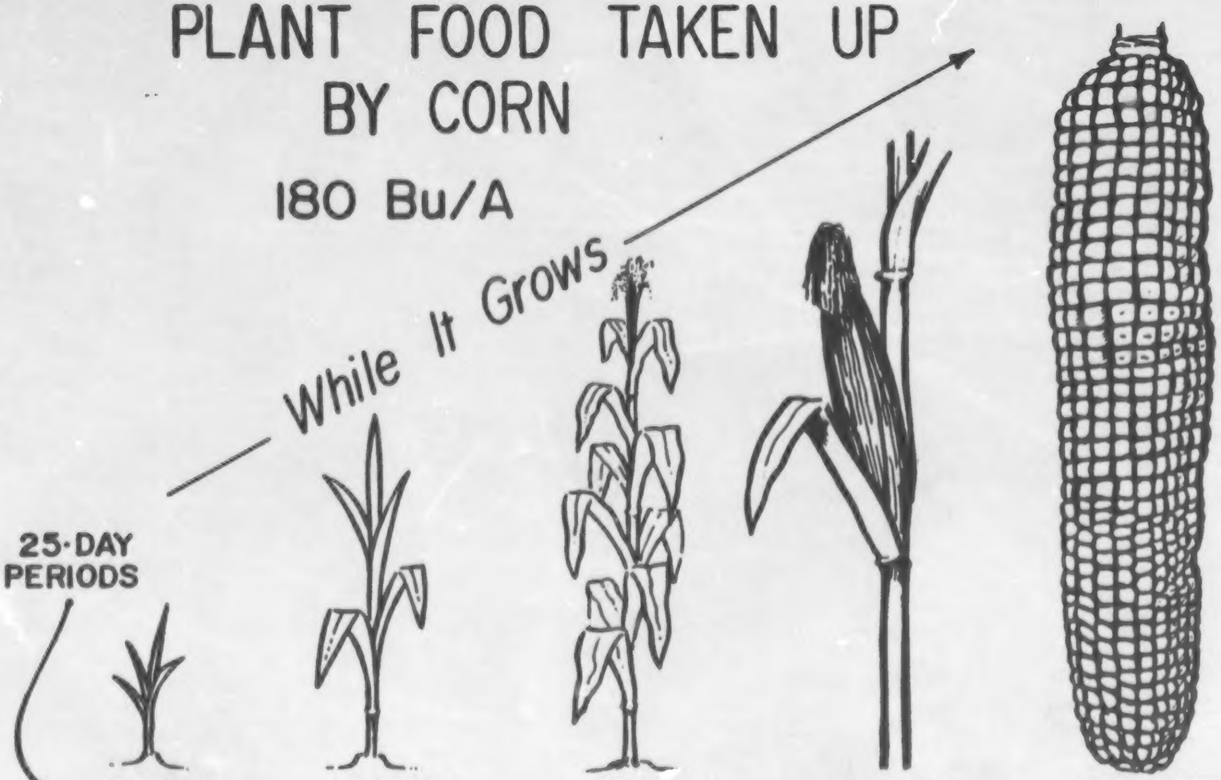

ROLE OF NUTRIENTS IN PLANT GROWTH
*NITROGEN
· necessary for
MAXIMUM
production
*PHOSPHORUS
· needed for full growth · helps roots absorb
*POTASSIUM
· strong stalks
· builds quality
A
1
*SULFUR
· forms chlorophyll
MOVES
PROTEIN
*IRON
· carries oxygen
· for chlorophyll
*ZINC
· necessary for normal growth and cell structure
· Seed Production
· circulates water
*MOLYBDENUM
· helps plant use other nutrients
*CALCIUM
· keeps leaves from twisting
· helps root tips function
*MAGNESIUM
· transports phosphorus
Ph
Ph
*MANGANESE
· necessary to mature
· guards against CHLOROSIS
FIGHTS DISEASE
*COPPER
· root growth
· mineral nutrition
· cell growth
*BORON
· regulates elements
· pollen germination
S. Tike

Some of the functions pointed out may not necessarily be the most important function of that particular element.

SOURCE: Crops and Soils Magazine.

PLANT FOOD TAKEN UP
BY CORN

180 Bu/A

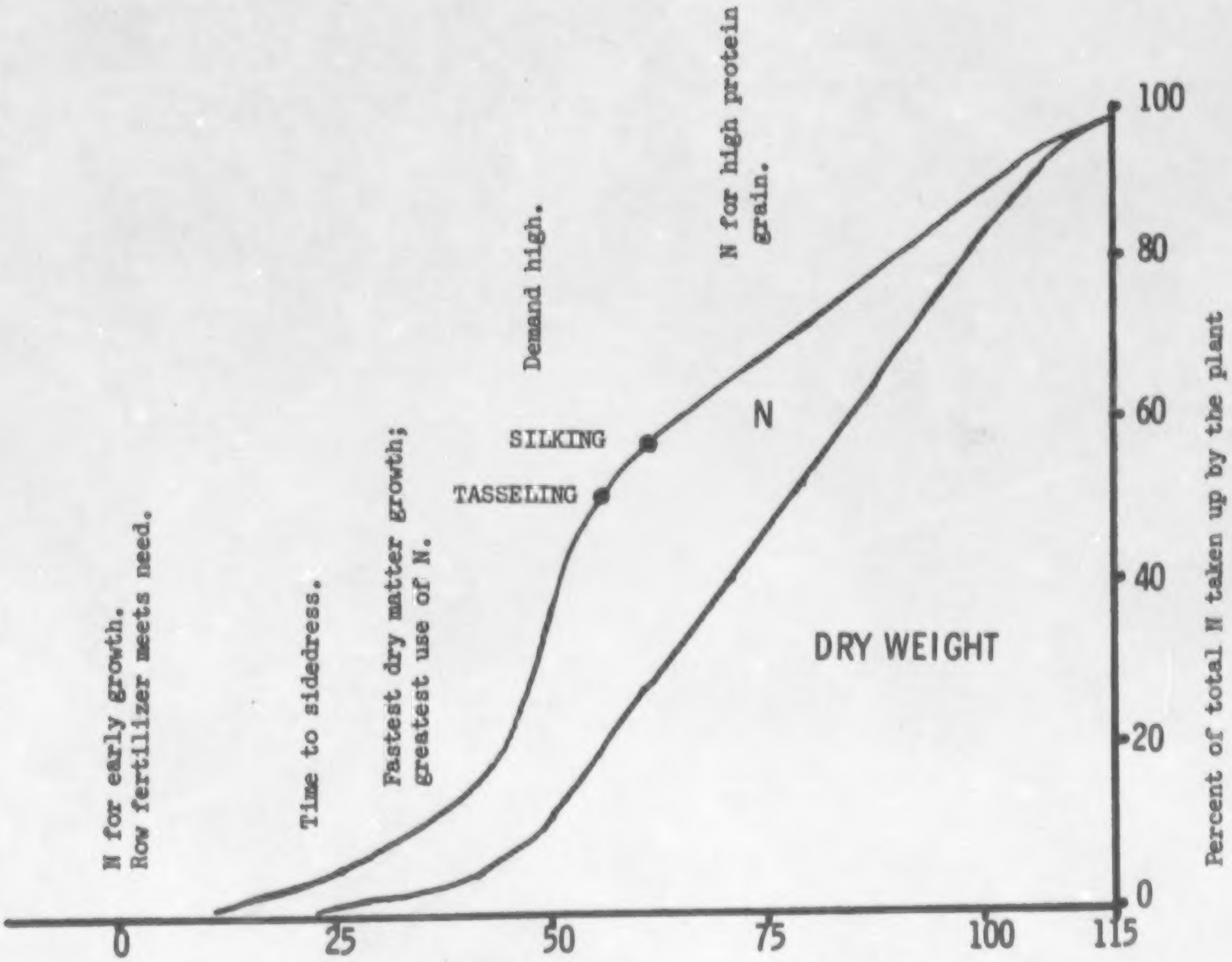

While It Grows
25-DAY PERIODS

	EARLY	GROWTH	SILK	GRAIN	MATURE	TOTAL	
N	19 lb	84 lb.	75 lb	48 lb	14 lb	240	UPTAKE 580 lb
P_2O_5	4	27	36	25	8	100	
K_2O	22	104	72	36	6	240	
DRY MATTER	468	3212	5687	6022	1338	16,727 lb	

IM 5.2.2b

TM 5.2.2c

NITROGEN IN THE LIFE OF THE CORN PLANT*



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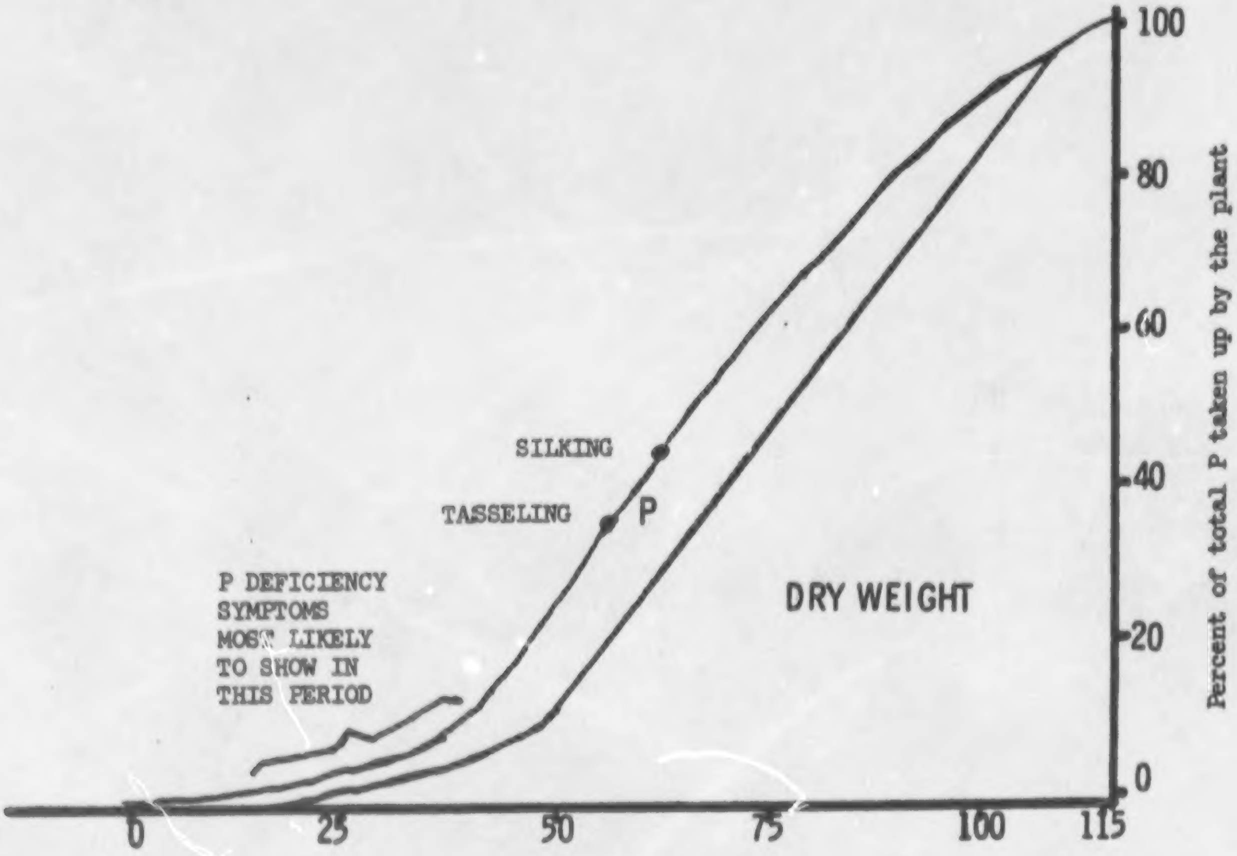
*There are roughly 2 lbs. of N per bushel of yield in the roots, stover and grain.

Source: Adapted from Modern Corn Production.

TM 5.2.2d

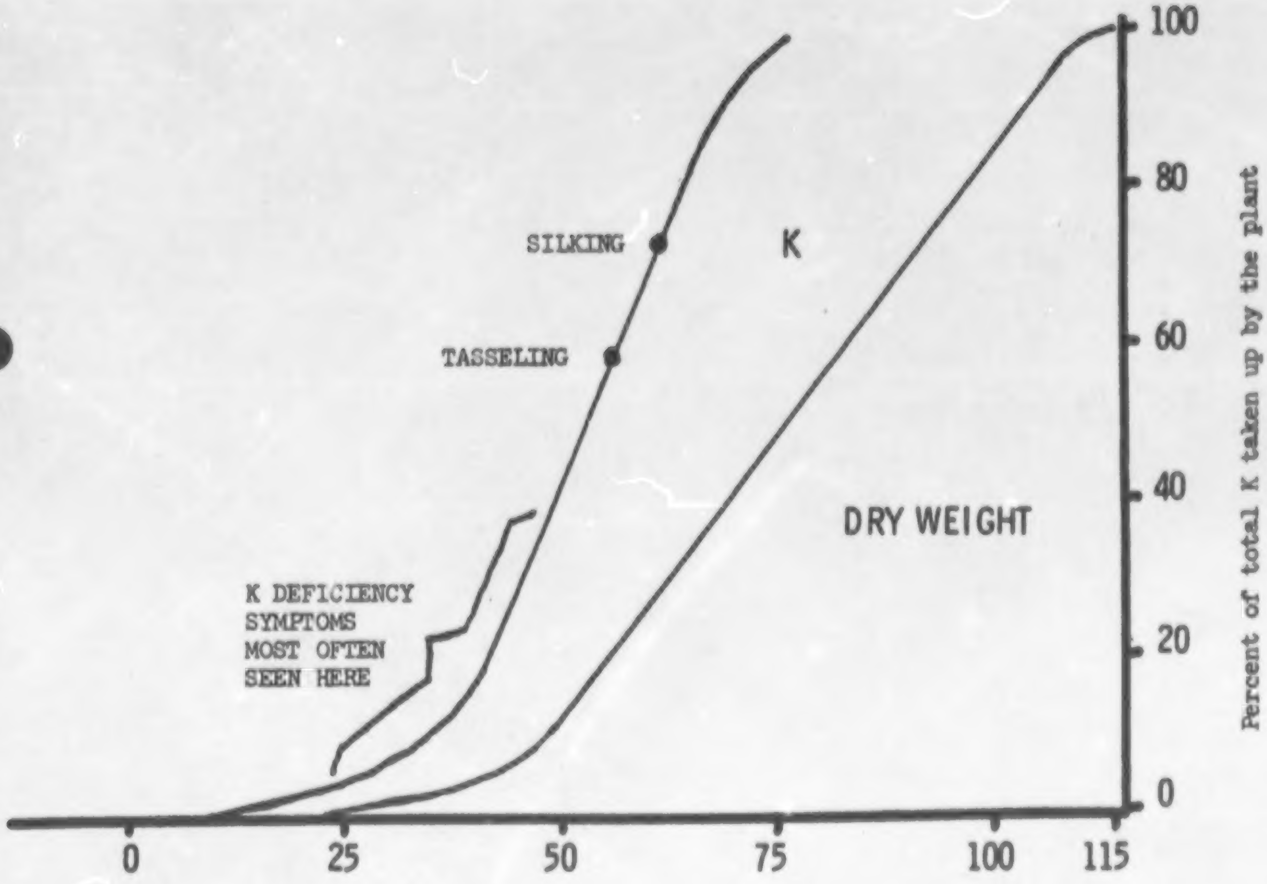
PHOSPHORUS IN THE LIFE OF THE CORN PLANT



Note: Phosphorus is taken up throughout the life of the corn plant, but the most critical period is early in the season. At that time, the capacity of the root system to obtain phosphorus is low. The reddish-purple deficiency symptoms rarely show after corn is 24 to 30 in. tall.

Source: Adapted from Modern Corn Production.

POTASSIUM IN THE LIFE OF THE CORN PLANT



Source: Adapted from Modern Corn Production.

6. PESTS -- WEEDS, INSECTS, AND DISEASES OF CORN

6.1 Performance Objective

Given a written check-out activity concerning pests, the student will complete the activity with 80 percent accuracy.

6.2 Teaching-Learning Activities

a. This section on pests can best be taught using the problem-solving procedure. Prepare appropriate problems for class use.

b. If the class you are teaching has not previously covered weed control, you should look at competency-based vocational education modules NP-55 or GG-71, "Applying Weed Killing Compounds" and NP-49, "Cultivating Nursery Crops" or Section 21, "Using Chemicals to Control Weeds" from the Tobacco Production Unit in this series.

c. Take field trips to:

(1) Observe weeds and weed control.
(2) Observe insects, insect damage, and insect control.
(3) Observe diseases, disease damage, and disease control.
(4) Visit a test plot to observe disease resistance.
(5) Apply pest control.
(6) Calibrate a sprayer and determine chemical needs of a corn crop.
(7) Visit a local farm supply dealer to become acquainted with the chemicals available for control of corn pests.

d. Establish a demonstration plot near the school which shows pest control and disease resistance.

e. Make pictures (slides) of the results of herbicides used in the community.

f. Have available samples of the herbicides used to control weeds in corn. Have price lists for each.

g. Use farmers and representatives of chemical companies as resource persons for this class.

h. Make transparencies or handouts from the transparency masters.

i. Obtain samples of weeds, weed seeds, insects, and plants showing insect and disease problems (slides or filmstrips may be used) as well as labels of chemicals that can be used to control weeds and insects.

6.2.1 Identify the major corn pests and the damage they do to the plant and grain.

a. The major corn weed pests in Kentucky are: Johnson grass, cocklebur, jimsonweed, lambsquarter, common ragweed, giant ragweed, pigweed, velvetleaf, foxtail, fall panicum, crabgrass, wildcane, and nutgrass. All of these will reduce yields by using plant nutrients, moisture, and shading. Some of these weeds also serve as a host for insects and diseases that infest corn (see transparency master 6.2.1a).

b. The major insect pests of corn in Kentucky and the damage they do are: (See transparency masters 6.2.1b and 6.2.1c)

   (1) Cutworms - cut off plants when small.
   (2) Corn rootworms - three species (Southern, Northern, and Western), feed on roots, thereby weakening the root system and reducing yield.
   (3) Wireworms - consume the newly planted seeds or seedlings and feed on plant's roots.
   (4) Seed corn maggot - feed on the germ part of unsprouted seed or on newly sprouted seed.
   (5) Flea beetle - feed on corn leaves; they are also carriers of a bacterial wilt of corn called Stewart's Disease.
   (6) European corn borer - young larvae feed on the leaves of corn plants and later bore into the stalks, ear shanks and ears. They may weaken the stalks and ear shanks to the extent that the ear may drop prematurely or the stalk may break over.
   (7) Southwestern corn borer - feed on the leaves, the larvae bore into the stalk near the ground level; they then girdle the stalk causing it to break off.
   (8) Grain weevils, beetles, and moths - eat and contaminate stored grain.
   (9) Other insects that occasionally infest corn are: true and fall armyworm, seed corn beetle, grasshopper, common stalk borer, corn root aphid, white grub, nematodes, grape colaspis, sod webworms, corn leaf aphid, chinch bugs, and corn earworms.

c. The major diseases of corn and their damage are: (See transparency master 6.2.1d)

   (1) Seed rots and seedling blights - (several) stand poor and uneven; seedlings wilt; may die.
   (2) Northern corn leaf blight - causes dead areas to appear on corn leaves; if infestion is early and heavy, it may cause chaffy kernels.
   (3) Bacterial wilt and leaf blight (Stewart's Disease) - field corn is not usually affected with the wilt phase; causes lesions on the leaves; may stunt plant and prevent production of normal ears.
   (4) Southern corn leaf blight (SCB) - causes lesions on leaves and husks. Severe infestation causes decay of grain and cobs.

(5) Maize dwarf mosaic MDM and MCDV - discolored leaves, stunted stalks and small or no ears.
(6) Common smut - black, sooty galls form on plant. Common smut on the ears and/or where ears were supposed to form or on the ear.
(7) Stalk rots - Gibberella, Diplodia, Charcoal, and Fusarium, all cause the stalk to deteriorate and perhaps fall. If infestation is early, they will reduce yields.
(8) Ear rots - Diplodia, Gibberella, Nigrospora, and Fusarium, all cause decay of cob and kernel and loss of usefulness.
(9) Storage rots and molds - several; one of the more serious is aflatoxin; cause damage and loss of stored grain.
(10) Other less common corn diseases that may be found in corn growing in Kentucky are: Pythium and bacterial stalk rots, yellow leaf blight, eyespot, common rust, downy mildew, gray ear rot, brown spot, leaf freckles and wilt (Goss's Wilt).

6.2.2 Select cultural and chemical control practices for weeds, insects, and diseases of corn that are safe and effective.

a. Since pesticide recommendations change very rapidly, it is necessary to keep and refer to the latest cooperative extension publications to be sure one is using the best, safest, and properly registered chemical or method.

Follow carefully the precautions stated on the label of the bag or container. It is hazardous to use pesticides for purposes other than those specified on the approved label. Use pesticides only for purposes for which they are approved and recommended. Use only recommended amounts. Besides wasting money, using too much material may damage the crop and make it unsafe for food or feed. The seizure of any raw agricultural commodity moving in interstate commerce which carries a pesticide residue in excess of the established tolerance is authorized by the Environmental Protection Agency.

Apply pesticides only at times specified on the label, and observe the recommended intervals between the time of treatment and time of planting, pasturing or harvesting the crop. Guard against possible injury to nearby susceptible crops or plants.

In general, the use of pesticides should supplement good farm practices, such as:

(1) Use of high quality crop seed free of weed seed, insects and disease.
(2) High soil fertility and good crop rotation.
(3) Practices that prevent weeds from producing mature seeds.

b. Control of weeds in corn is usually done with the use of chemicals. Most chemical control is by the use of a broadleaf control herbicide and a grass control herbicide. Several effective herbicides are presently available on the market. Selection should be based upon weed problem, cultural method being used (no-till or conventional), application method (preplant incorporate, preplant or pre-emerge, or post-emerge), and soil texture.

c. Control of insects can be accomplished by destroying host plants and residue through controlling weeds and other vegetation and by plowing or other methods of eliminating surface plant residues. There are many good insecticides to control soil insects, insects that damage the vegetative portion of the stalk, and stored grain (see transparency master 6.2.2a).

d. Diseases of corn can be controlled by destroying disease-infested plant residue, control of insects and other plants that spread various diseases, good fertilization program, harvest at proper time, and storage at correct moisture. Some of the diseases may be controlled by use of fungicides, but most are not economically controlled by fungicides. Selection of resistant hybrid varieties is the best way to control these diseases, particularly for virus diseases.

6.2.3 Estimate the economic loss due to reduced yield, increased harvesting loss, or reduced quality that can be attributed to corn pests.

a. Weeds in corn fields compete with the corn for plant food, moisture, and sunlight; they also present harvest problems and can become mixed into the harvested grain. In one test where no weeds were allowed to grow, a field produced 130 bushels. A field where weeds were permitted to grow for three weeks produced a reduced yield of 112 bushels. One pigweed per 3 1/3 feet of row was found to reduce yield by 7 bushels per acre.

b. Insects may destroy over 90 percent of a corn field. Insects spread disease, weaken the plant, reduce the yield, cause harvest problems, and consume and damage stored grain.

c. Corn diseases cause 7 percent to 20 percent yield losses annually. Diseases cause weakened, stunted, or dead plants, reduced yields, harvest problems, and damaged or unuseable grain.

6.3 Supplementary Materials

References:
1. Aflatoxin, VET-21.
2. Chemical Control of Weeds in Farm Crops in Kentucky - 1979, AGR-6.
3. Controlling White Grubs, ENT-10.
4. Diseases of Corn in the Midwest, Cir. 967.
5. Modern Corn Production.
6. Safeguard Yourself . . . When Using Insecticides, ENT-26.

7. *The Migro Complete Corn Farmers Handbook*.

8. *1979 Insecticide Recommendations for Conventional and No-Tillage Field Corn*, ENT-16.

Filmstrips:
1. "Identification of Weeds," Part I VAS 791.
2. "Identification of Weeds," Part II VAS 792.
3. "Controlling Giant Foxtail," VAS 794.
4. "Using Pre-Emergence Herbicides," VAS 797.
5. "Recognizing Herbicide Injury."
6. "A Systematic Approach to Weed Control," VAS 799.

Movies:
1. "Pesticides: Fundamentals of Proper Application."
2. "Pesticides in Focus."
3. "Soil Insect Control."

Transparency Masters:
1. 6.2.1a, "Major Weed Pests of Corn in Kentucky."
2. 6.2.1b, "Insect Pests of Corn."
3. 6.2.1c, "Insect Pests of Corn, Continued."
4. 6.2.1d, "Common Diseases of Corn in Kentucky."
5. 6.2.2a, "Insect Control Measures."

6.4 Check-Out Activities

1. Name six weeds that are a major problem in Kentucky.
2. Name six insects that cause major problems in corn in Kentucky.
3. There is more than one species of corn rootworm. T F
4. What are five of the major corn diseases in Kentucky?
5. Some of the corn diseases are carried by insects. T F
6. Most weeds in corn are now controlled by cultural practices. T F

ANSWERS:

1. a. Johnson grass
   b. Cocklebur
   c. Jimsonweed
   d. Lambsquarter
   e. Common ragweed
   f. Giant ragweed
   g. Pigweed
   h. Velvetleaf
   i. Foxtail
   j. Fall panicum
   k. Crabgrass
   l. Wildcane
   m. Nutgrass
2. a. Cutworms
   b. Corn rootworms
   c. Wireworms
   d. Seed corn maggot
   e. Flea beetle
   f. European corn borer
   g. Southwestern corn borer
   h. Grain weevils, beetles and moths
3. True
4. a. Seed rots and seedling blights
   b. Northern corn leaf blight
   c. Bacterial wilt and leaf blight (Stewart's Disease)
   d. Southern corn leaf blight
   e. Maize dwarf mosaic MDM and MCDV
   f. Common smut
   g. Stalk rots
   h. Ear rots
   i. Storage rots and molds
5. True
6. False

MAJOR WEED PESTS OF CORN IN KENTUCKY

JOHNSON GRASS
COCKLEBUR
JIMSONWEED
LAMBSQUARTER
COMMON RAGWEED
GIANT RAGWEED
PIGWEED
VELVETLEAF
FOXTAIL
FALL PANICUM
CRABGRASS
WILDCANE
NUTGRASS

INSECT PESTS OF CORN

STAGE	INSECT
Planting to Knee-High	Seed-corn maggot
	Seed-corn beetle
	Thief ant
	Wireworm
	Cut worm
	Sod webworm
	Grape colaspis
	White grub
	Common stalk borer
	Corn flea beetle
	Thrip
	Yellow-striped army worm
Knee-High to Tasseling	Chinch bug
	Fall army worm
	Corn rootworms
	Corn borer - Northern
	Western
	Southern
	European
Tasseling to Maturity	Woolybear caterpillar
	Corn leaf aphid
	Japanese beetle
	Corn earworm
	Picnic beetle
	Corn sap beetle
	European corn borer
	Katydid
	Grasshopper
	Southwestern corn borer
	Corn rootworm - Western
	Northern
	Southern

Insect Pests of Corn, continued

STAGE	INSECT
Stored Corn	Granary weevil Saw-tooth grain beetle Red flour beetle Rice weevil Indian meal moth Cadella beetle Flat grain moth Angoumois grain moth Foreign grain beetle Rusty grain beetle

COMMON DISEASES OF CORN IN KENTUCKY

SEEDLING

Stalk Rot

Seedling Blight

LEAF

Northern Corn Leaf Blight

Southern Corn Leaf Blight

Stewart's Disease (bacterial wilt)

Common Corn Rust

Crazy Top (downy mildew)

MDM (maize dwarf mosaic)

STALK

Diplodia Stalk Rot

Gibberella Stalk Rot

Charcoal Rot

Pythium Stalk Rot

Pythium Root Rot

Common Smut

EAR

Diplodia Ear Rot (dry rot)

Fusarium Kernel Rot

Migrosporo Ear Rot (cob rot)

Gibberella Ear Rot (red ear rot)

Gray Ear Rot

BEST CONTROL = RESISTANT VARIETIES

INSECT CONTROL MEASURES

- Rotate crops
- Select tolerant varieties
- Destroy plant residue
- Keep weeds down in adjoining fields
- Use insecticides properly

7. HARVESTING AND STORING CORN

7.1 Performance Objective

Given a written check-out activity concerning harvesting and storing corn, student will complete activity with 80 percent accuracy.

7.2 Teaching-Learning Activities

a. This section on harvesting and storing corn can best be taught using the problem-solving procedure. Prepare appropriate problems for class use.

b. Take field trips to:

(1) see corn harvested properly.
(2) determine preharvest and harvest losses.
(3) determine the moisture of corn.
(4) check yield of corn.
(5) visit corn storage and calculate storage capacity of several storage facilities.
(6) visit corn drying and handling facilities.
(7) observe storing, drying and handling systems at the National Farm Machinery Show.

c. Obtain samples of grain with insect and mold damage to show the class. (Slides may be used.)

d. Make and use transparencies or handouts from transparency masters.

e. Use extension personnel or local grain buyer as a resource person.

7.2.1 Determine harvesting losses of corn and make the necessary machine adjustments.

a. Corn losses include both preharvest losses and harvesting losses.

(1) Preharvest losses consist of ears that drop from the stalk before harvest begins.
(2) Harvesting losses can be separated into the following types of losses: Gathering losses occur at the front of the combine, and consist of ears missed or dropped by the machine and loose kernels shelled by the stalk rolls on the cornhead. Cylinder and separating losses will be found on the ground behind the combine. Cylinder losses are kernels attached to pieces of cob that were not shelled by the combine cylinder. Separating losses are loose kernels that were not shaken out of the cobs and husks and were lost over the back of the combine.(See transparency master 7.2.1a for figuring losses.) (See transparency master 7.2.1b to determine length of row to make 1/100 acre.)

b. After the cause and amount of these losses have been determined, the machine should be adjusted according to the operator's manual.

7.2.2 Properly harvest corn.

Harvesting of corn should be done with the machine properly adjusted, at the correct speed, and when the corn is at a desirable moisture level to prevent ear loss and kernel damage.

7.2.3 Determine the moisture content for corn for proper time of harvesting for grain and for silage (see transparency masters 7.2.3a, 7.2.3b, and 7.2.3c).

a. Corn is physiologically mature when black layer formation occurs. The moisture level will vary but will be near 35 percent moisture. Most corn will be ready to harvest at 30 - 32 percent moisture.

The highest yield of dry matter (D.M.) will be put in the bin per acre when harvesting commences at 28 percent and continues through completion of harvest. At moisture levels above 30 percent, there is considerable kernel damage. At moisture levels below 17 percent, considerable shelling by the combine header occurs.

b. The best time to harvest silage for high yield and quality is when the kernels have all dented and black layer formation is occurring. A black layer is formed near the base of the kernel when the kernel is physiologically mature. Harvesting for silage should be done in the first few days of this period while the leaves are still mostly green above the ear. The moisture content of the silage should be near 65 percent. If the crop is harvested at a stage when the silage is too dry, extra water must be added to prevent mold from developing in storage. If the silage is harvested too wet, excessive drainage from the silage will result in loss of most of the nutrients. When using trenches, bunkers or stacks, the moisture content of the silage should be above 65 percent in order to obtain adequate packing. The silage should be chopped at a length of approximately 3/8 - 1/2 inch. This will help insure proper fermentation by releasing plant juices and permitting better packing for oxygen exclusion. The result should be high quality silage. Transparency master 7.2.3d describes a simple field technique for determining moisture.

7.2.4 Identify and select the storage facilities and equipment needed for various methods of corn harvest.

a. Types of structures for storage of the crop if harvested on the ear at low moisture level are varied (wire bins, wooden cribs, etc.). Emphasis should be placed on prevention of insect, rodent, and weather damage when using these structures. Shelled corn presents more of a storage problem since very little is harvested at the safe moisture level for storage. Most must have some drying to prevent spoilage. The methods of storage and drying and their limitations are:

(1) Dry and store in the same structure (layer drying) - fits farmers handling up to 10,000 bushels yearly. If unheated air is used for drying, the corn needs to be harvested at 18 percent to 22 percent moisture; if heated air is used, the corn may be harvested as high as 25 percent.
(2) Batch-in-bin - for the farmer handling 7,500 or more bushels. Corn can be harvested at 18 percent to 30 percent moisture. Layers of corn from 2 feet to 4 feet deep can be dried from 25 percent to 14 percent daily.
(3) Portable batch - for the farmer with 7,500 or more bushels. Corn can be handled up to 32 percent moisture with this method.
(4) Continuous flow - for the farmer with 10,000 or more bushels. Corn at 30 percent moisture can be harvested for drying with this method.

b. If heat is used in any of these methods, it will not matter what temperature is used for drying if corn is fed to livestock. Corn that is used for processing should not be dried at temperatures above 140°F, since it damages the starch and reduces the oil content in the grain. Commercial grain storage is available in some grain producing areas for farmers who do not have on-farm storage; however, very little commercial grain storage is available in many areas of Kentucky for farmers with more production than their storage capacity and for renters.

7.2.5 Select a harvesting and storage system for corn based on efficiency and economy.

For setting up a storage and drying system on your farm, use the computer recommendations available from the University of Kentucky.

The different methods of corn harvest and storage are:

a. Ear-corn picker, crib storage, no drying - This has been the most widely used system in years past, but has been taken over by harvesting with a corn head on a combine on most Kentucky farms. It is most practical for a total crop of 4,000 bushels or less. You can't start to harvest until the grain is down near 20 percent moisture. If you have a large acreage, the last part harvested is likely to suffer large field losses from lodging, broken stalks, ear drop, and picking losses.

b. Ear-corn picker, storage as high moisture corn in a silo - This system reduces field losses to about one half of losses as with Method a. However, more capital must be invested with the silo.

c. Picker-sheller - If the corn goes directly to market or into your own dryer, field losses with a picker-sheller are only slightly more than for picking ear corn of the same moisture content.

d. Combine with a corn head - Field losses for this method are about 20 percent less than with an ear-corn picker. You need 7,500 or more bushels of corn plus additional bushels of soybeans or small grains to make this method most economical. Lowest losses of all are for combine harvest and storage as high moisture corn.

7.2.6 Drying the crop for safe storage and sale.

a. The principle of drying corn is simply one of evaporating moisture from the corn. Moisture moves from one place to another according to a difference in vapor pressure; that is, moisture will move from an area of high vapor pressure to one of low vapor pressure. The vapor pressure of both corn and air depends upon the temperature and moisture content. The moisture content which corn attains in air of a given relative humidity (the ratio, expressed in percent, of the moisture actually in the air to the moisture it would hold if it were saturated at the same temperature and pressure) at a certain temperature is known as the equilibrium moisture content. The equilibrium moisture content is reached when the grain and the water vapor and the air are at the same temperature. If the air is 80°F and 60 percent humidity is moved around wet shelled corn, the corn cannot be dried below 11.2 percent moisture content, which is the equilibrium moisture content (see transparency master 7.2.6a).

(1) Drying with unheated air is less expensive, produces less fire hazard, and has lower initial cost of equipment. It is dependent on weather conditions, dries more slowly, and the longer drying time may result in damage by growth of molds, but can be done successfully with good management.
(2) Drying with heated air is quicker, can handle wetter grain, and is not dependent on weather conditions.

b. Shelled corn is purchased at 15.5 percent moisture content, so drying below this results in a loss to the grower. For short-term storage, this moisture level is satisfactory, but for long term (over 4 months), it should be dried to 13 percent moisture. Ear corn can be stored for a short period at 20 percent moisture, but should be dried to 17 percent if stored for more than 4 months (See transparency masters 7.2.6b and 7.2.6c).

7.2.7 Calculate the volume of a structure needed to store a certain number of bushels of corn.

If the volume of the structure is known, the following volume conversions can be used: Shelled corn -- cubic feet x 0.8 equals bushels; Ear corn - cubic feet x 0.4 equals bushels.

Conversions for finding volume and capacity:

Shelled Corn

Rectangular Bin: Bushels = 0.8 x length x width x average depth (all in feet)

Round Bin: Bushels = 0.6283 x diameter x diameter x average depth (in feet)

Ear Corn

Rectangular Crib: Bushels = 0.4 x length x width x average depth (all in feet)

Round Crib: Bushels = 0.31416 x diameter x diameter x average depth (in feet)

Piled Grain

Shelled Corn: Bushels = 0.20944 x height x diameter of base x diameter (in feet)

Ear Corn (shelled basis): Bushels = 0.10472 x height x diameter of base x diameter of base (in feet)

(See transparency masters 7.2.7a, 7.2.7b, and 7.2.7c.)

7.2.8 Treat stored corn for pest control.

a. Grain can be stored over a period of several years with little or no loss of quality if stored under proper conditions. Often, spoilage occurs in grain as a result of microbes which develop or insect infestation. The conditions which influence the development of the microbes are:

(1) The moisture content of the grain.
(2) The temperature.
(3) The oxygen supply.
(4) The pH.
(5) The condition or soundness.
(6) The amount of foreign material present in the grain.

b. Corn stored should be handled properly to prevent the mold which produces the toxin named aflatoxin. Aflatoxin is one of the most carcinogenic and toxic materials known to affect mammals, fish, and birds. A dosage of only 0.5 parts per million (ppm) of aflatoxin reduced growth, while 2 parts per million caused death in one to three days in swine. Grain containing aflatoxin will be condemned and must be destroyed. Preventive practices to follow to avoid development of aflatoxin are:

(1) Harvest corn as soon as moisture content allows without excessive grain damage.
(2) Adjust combine for minimum cracking and maximum cleaning of grain.
(3) Dry grain as soon as practical, but reduce the moisture to 16 percent or below within 48 hours after combining.
(4) Remove foreign material before storing the grain.
(5) Clean the storage facility and treat for insects.
(6) Store in water-, insect-, and rodent-tight structure.
(7) Cool the grain after drying.
(8) Areate stored grain to control temperature and moisture migration.

c. Insects often infest grain stored during the warm months of the year. The results of their infesting the grain are: grain being consumed by the insects, contamination by insect excretion, lower test weight and quality of grain. Infestation also permits entry of fungi and bacterias. Ways of reducing insect problems in the grain are:

(1) Clean out storage facilities of all old grain before storing new crop of grain.
(2) Fumigate storage facilities with an approved fumigant.
(3) Treat new grain, when being stored, with an approved insecticide, such as premium grade malathion.
(4) Check stored grain periodically (every 30 days) for insects; when infestation becomes economically feasible (one granary weevil or rice weevil per quart of grain sampled), fumigate the grain.

7.3 Supplementary Materials

References:

1. Aeration, Inspection and Sampling of Grain in Storage Bins, AEN-45.
2. Chemical Preservation of Grain, AEN-21.
3. Controlling Insects in Stored Grain, ENT-19.
4. Dryeration Performance Evaluation, AEES-8.
5. Economics of Drying, Storage and Feed Processing: Part I, Operational Considerations, AEN-33.
6. Economics of Drying Storage and Feed Processing: Part III, Storage Considerations, AEN-35.
7. Economics of Drying Storage and Feed Processing: Part IV, Feed Processing, AEN-41.
8. Estimating Fan Sizes for Grain Drying and Storage Bins, AEES-6.
9. Grain Drying Performance Evaluation, AEES-7.

10. Layout of Grain Storage and Handling Facilities, AEN-1.

11. Low Temperature Drying: Methods and Management, AEN-22.

12. Low Temperature Drying: Use and Limitations, AEN-23.

13. Modern Corn Production.

14. Performance Evaluation for National Air and Low-Temperature Drying Systems, AEES-9.

15. Potential of Biomass Conversion Processes for Grain Drying in Kentucky, AEES-4.

16. Principles of Grain Storage, AEN-20.

17. Producing Corn for Grain and Silage, AGR-79.

18. Reducing Corn Harvest Losses, Leaflet 307.

19. Suffocation Hazards in Grain Bins, AEN-39.

Movies: 1. "Breakthrough in Combining."

2. "Bringing it Home."

3. "Combine Safety."

4. "Coming Out Ahead."

5. "Cornlage."

6. "High Moisture Corn Farming."

7. "Hole in the Pocket."

8. "Look to the Harvest."

9. "The Proof is in the Harvest."

10. "Why Dry Corn."

Slides: 1. "Combine, Principles of Operation."

2. "Efficient Machine Harvesting."

Transparency Masters: 1. 7.2.1a, "Figuring Harvesting Losses."

2. 7.2.1b, "Length of Row for 1/100 Acre."

3. 7.2.3a, "Dry Weight of Maturing Corn."

4. 7.2.3b, "Estimating Moisture Content in Grain of Corn."

5. 7.2.3c, "How to Tell When Corn Will Mature."

6. 7.2.3d, "Field Techniques for Estimating Moisture Content of Forage."

7. 7.2.6a, "Equilibrium Moisture Content of Shelled Corn for Various Air Temperatures and Relative Humidities."

8. 7.2.6b, "Formula for Determining What a Given Amount of High Moisture Shelled Corn Will Weigh When Dried to Standard Moisture Content (15.5 Percent)."

9. 7.2.6c, "Maximum Time for Storage of Shelled Corn at Various Corn Moisture Contents and Air Temperatures."

10. 7.2.7a, "Storage Capacity for Common Round Bins."

11. 7.2.7b, "How to Calculate Storage Capacities."

12. 7.2.7c, "How to Figure Corn Acreage."

7.4 Check-Out Activities

1. Corn is physiologically mature when black layer formation occurs. T F

2. The least harvest losses occur when grain is harvested at 17 percent moisture. T F

3. Yellow shelled corn is purchased at what percent moisture? ____

4. If corn is to be stored during the spring and summer months, at what moisture should shelled corn and ear corn be stored?

5. Corn that is used for processing should not be dried at temperatures above 140°F. T F

6. Corn can be dried to safe-keeping level with unheated air. T F

7. Aflatoxin is an insect that causes problems in stored grain. T F

ANSWERS:

1. True
2. False
3. 15.5 percent
4. a. 13 percent shelled
   b. 17 percent ear corn
5. True
6. True
7. False

FIGURING HARVESTING LOSSES

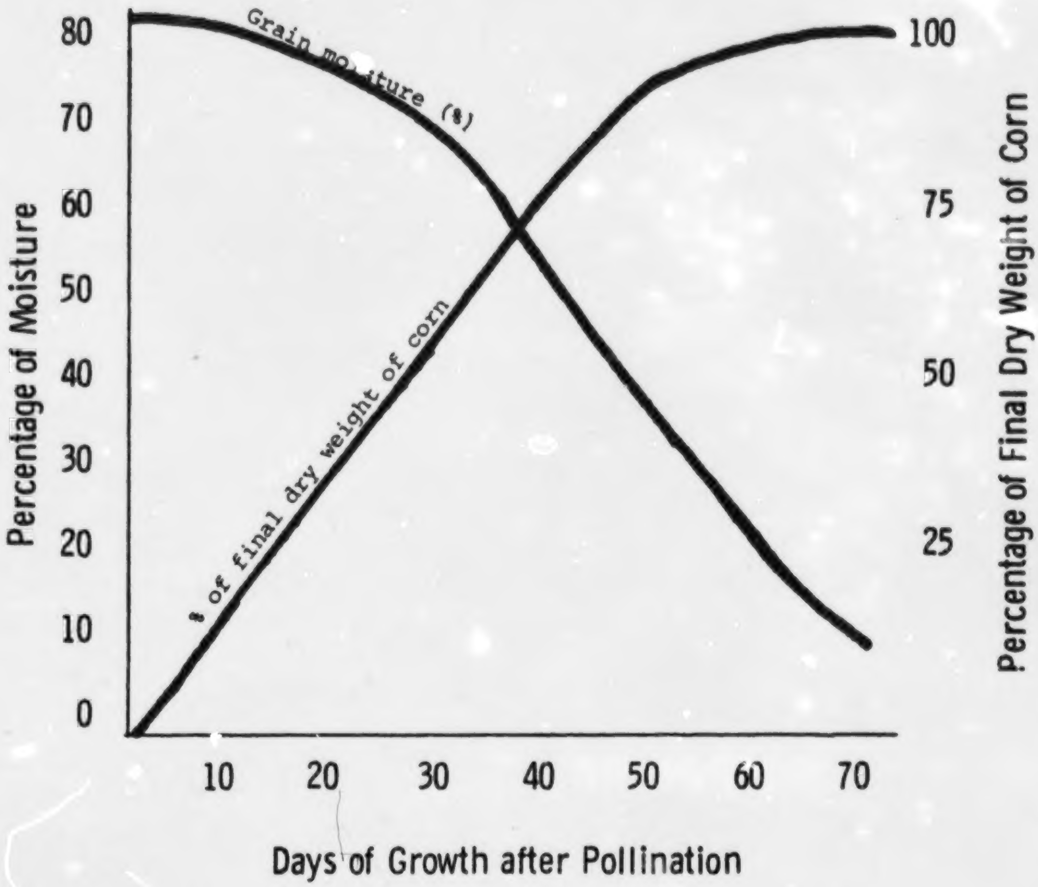
1. COUNT KERNELS AND EARS OVER A NUMBER OF AREAS SELECTED AT RANDOM.
2. TWO KERNELS PER SQUARE FOOT AVERAGE WILL EQUAL A LOSS OF ONE BUSHEL PER ACRE.
3. ONE GOOD SIZED EAR IN A 1/100 ACRE SECTION OF ROW WILL ALSO EQUAL A LOSS OF ONE BUSHEL PER ACRE. (SEE TRANSPARENCY MASTER 7.2.3B.)
4. ANYTIME HIGH LOSSES ARE FOUND, MACHINERY SHOULD BE ADJUSTED TO CORRECT FOR THE PROBLEM.

Length of row for 1/100 acre

Row width	Length of row
20″	262 feet
30″	174 feet
32″	163 feet
34″	154 feet
36″	145 feet
38″	137 feet
40″	131 feet

TM 7.2.1b

DRY WEIGHT OF MATURING CORN



TM 7.2.3b

ESTIMATING MOISTURE CONTENT IN GRAIN OF CORN*

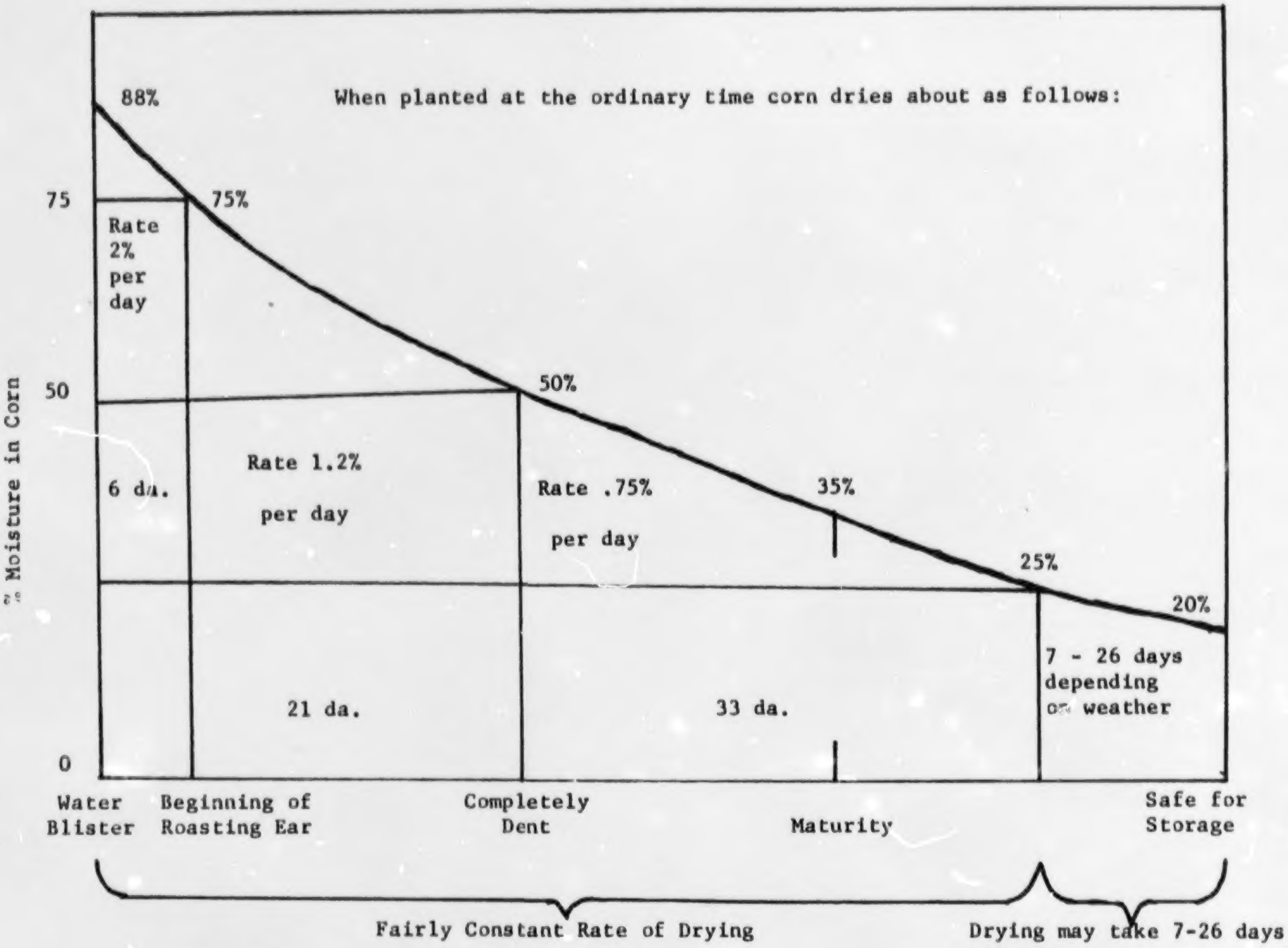
Description of Grain and Cob	Percent of Moisture in Grain
Wet; about half of the grain per ear dented.	60
Most ears well-dented; milk present in undented grain.	50
Kernels fully dented; germs still swollen; free water found in tips of grain by biting point of grain. Hard starch of kernel only partly developed and extending halfway down the back of the kernel, the remainder being soft, light-colored starch at the tip-end of the kernel; milk has been changed to soft starch at this stage. Ears solid; excess moisture gives the grain a glistening appearance.	40
Germs slightly swollen with free water in the tips of half the kernels. On the back of the kernel, the hard or "horny" starch should extend from the crown to the tip.	34
Germs rather smooth, swollen slightly at tip but slightly depressed at opposite end; free water in tips of very few kernels. Too wet to crib. Corn is made (ripe).	26
Germs concave (hollow, shrunken). Grains still drier than cob and ears slightly "twisty," with kernels not tight on the cob. Cribbing may proceed slowly at this stage.	23
All germs slightly concave; ears ready for rapid cribbing as indicated by the typical farmer "twisty" ear test; ears do not shell freely.	20
Germs moderately concave; kernels tight on cob.	17.5
Germs deeply concave; corn shells very easily; shelled grain rattles. On healthy ears, kernels are tight on cob, not loose or twisty.	15

NOTE: The grain loses moisture more rapidly than the cob, as indicated by the kernels loosening on the cob. As the cob loses excess moisture, the ear again tightens. It becomes solid when the grain and the cob have a moisture content of about 15 percent.

*Agronomy Department, Estimating Moisture Content in Grain of Corn (Lafayette, Indiana: Agricultural Extension Service, Purdue University, 1956), pp. 1-2 (Mimoegraphed.)

Source: Drying Corn on the Farm.

HOW TO TELL WHEN CORN WILL MATURE*



*USDA Agr. Research, September, 1955.

Source: Drying Corn on the Farm.

Field technique for estimating moisture content of forage

Condition of Forage Ball	Approximate Moisture Content
When the ball holds its shape and there is considerable free juice	Over 75%
When the ball holds its shape but there is very little free juice	70 to 75%
When the ball falls apart slowly and there is no free juice	60 to 70%
When the ball falls apart rapidly	Below 60%

Source: Producing Corn and Grain for Silage.

EQUILIBRIUM MOISTURE CONTENT OF SHELLED CORN FOR VARIOUS AIR TEMPERATURES AND RELATIVE HUMIDITIES

Relative Humidity												
30	35	40	45	50	55	60	65	70	75	80	85	90
10.3	10.8	11.3	12.2	13.1	13.5	14.6	15.5	16.4	17.4	18.7	20.2	22.5
10.0	10.5	11.0	11.7	12.5	13.3	14.0	14.8	15.5	16.6	17.8	19.4	21.5
9.6	10.1	10.6	11.3	12.0	12.7	13.3	14.1	14.8	15.8	16.9	18.6	20.5
9.2	9.7	10.2	10.9	11.6	12.1	12.7	13.4	14.2	15.0	16.0	17.8	19.5
8.4	9.0	9.7	10.4	11.1	11.5	12.0	12.8	13.5	14.5	15.4	16.8	18.5
7.5	8.3	9.1	9.8	10.5	10.8	11.2	12.1	13.0	13.9	14.8	15.8	17.4

Can be overdried

Correct for long-time storage

Will not dry to safe moisture content under these conditions. Heat is needed

FORMULA FOR DETERMINING WHAT A GIVEN AMOUNT OF HIGH MOISTURE SHELLED CORN WILL WEIGH WHEN DRIED TO STANDARD MOISTURE CONTENT (15.5%)

(100 - Present Moisture Precentage) ÷ (100 - Standard Moisture Percentage) = Conversion Factor

Conversion Factor x Original Weight of Shelled Corn = Weight of Shelled Corn at Standard Moisture Percentage (15.5%)

Moist. %	Factor	Moist. %	Factor	Moist. %	Factor	Moist. %	Factor	Moist. %	Factor
30.00	.828	26.90	.865	23.90	.901	20.90	.936	17.90	.972
29.90	.830	26.80	.866	23.80	.902	20.80	.937	17.80	.973
29.80	.831	26.70	.867	23.70	.903	20.70	.938	17.70	.974
29.70	.832	26.60	.869	23.60	.904	20.60	.940	17.60	.975
29.60	.833	26.50	.870	23.50	.905	20.50	.941	17.50	.976
29.50	.834	26.40	.871	23.40	.907	20.40	.942	17.40	.978
29.40	.836	26.30	.872	23.30	.908	20.30	.943	17.30	.979
29.30	.837	26.20	.873	23.20	.909	20.20	.944	17.20	.980
29.20	.838	26.10	.875	23.10	.910	20.10	.946	17.10	.981
29.10	.839	26.00	.876	23.00	.911	20.00	.947	17.00	.982
29.00	.840								
28.90	.841	25.90	.877	22.90	.912	19.90	.948	16.90	.983
28.80	.843	25.80	.878	22.80	.914	19.80	.949	16.80	.985
28.70	.844	25.70	.879	22.70	.915	19.70	.950	16.70	.986
28.60	.845	25.60	.880	22.60	.916	19.60	.951	16.60	.987
28.50	.846	25.50	.882	22.50	.917	19.50	.953	16.50	.988
28.40	.847	25.40	.883	22.40	.918	19.40	.954	16.40	.989
28.30	.849	25.30	.884	22.30	.920	19.30	.955	16.30	.991
28.20	.850	25.20	.885	22.20	.921	19.20	.956	16.20	.992
28.10	.851	25.10	.886	22.10	.922	19.10	.957	16.10	.993
28.00	.852	25.00	.888	22.00	.923	19.00	.959	16.00	.994
27.90	.853	24.90	.889	21.90	.924	18.90	.960	15.90	.995
27.80	.854	24.80	.890	21.80	.925	18.80	.961	15.80	.996
27.70	.856	24.70	.891	21.70	.927	18.70	.962	15.70	.998
27.60	.857	24.60	.892	21.60	.928	18.60	.963	15.60	.999
27.50	.858	24.50	.893	21.50	.929	18.50	.964	15.50	1.000
27.40	.859	24.40	.895	21.40	.930	18.40	.966		
27.30	.860	24.30	.896	21.30	.931	18.30	.967		
27.20	.862	24.20	.897	21.20	.933	18.20	.968		
27.10	.863	24.10	.898	21.10	.934	18.10	.969		
27.00	.864	24.00	.899	21.00	.935	18.00	.970		

MAXIMUM TIME FOR STORAGE OF SHELLED CORN AT VARIOUS CORN MOISTURE CONTENTS AND AIR TEMPERATURES[1]

Storage air temperature (fahrenheit)	Corn moisture content			
	15%	20%	25%	30%
	Days	Days	Days	Days
75°	116	12.1	4.3	2.6
70°	155	16.1	5.8	3.5
65°	207	21.5	7.8	4.6
60°	259	27	9.6	5.8
55°	337	35	12.5	7.5
50°	466	48	17	10
45°	725	75	27	16
40°	906	94	34	20
35°	1,140	118	42	25

[1] The times given are those above which mold growth will cause enough loss in corn quality to bring about a lowering of grade.

Source: United States Department of Agriculture, Guidelines for Mold Control in High-moisture Corn, Farmers' Bulletin No. 2238 (Washington, D. C.: United States Government Printing Office, 1968), p. 4.

Storage capacity for common round bins.

Diameter in feet	Bu per foot of height	Capacities for Selected Depths in ft			
		11	13	16	19
14	125	1375	1625	2000	2375
18	203	2200	2635	3250	3850
21	277	3050	3600	4400	5300
24	362	4000	4700	5800	6900
27	458	5050	5950	7300	8700
30	565	6215	7345	9040	10735
36	814	8950	10600	13000	15450
40	1005	11050	13050	16100	19100

* Does not include space above eave line. Based on 15.5 MC corn and 1.25 cu ft per bushel.

SOURCE: Planning Grain-Feed Handling.

TM 7.2.7b

HOW TO CALCULATE STORAGE CAPACITIES

SHELLED CORN: Round storage: Multiply the diameter by its equal number; i.e., 12 ft. diameter x 12. Then multiply that total by footage depth. Multiply your total by .630.

Rectangular storage: multiply the footage width x depth x length. Multiply this total by 4 and divide by 5.

Piles: When cone shaped multiply the diameter by the equal number. Than multiply that total by greatest footage depth. Multiply your sum by .210.

CORN SILAGE: Trench silos: Multiply average width x average depth x length = cubic feet. Multiply sum by 36 (average weight cubic feet silage) for total pounds.

Upright silos: Toonage capacity of silage at 65 percent moisture.

SILO DIAMETER (FEET)

SILO HEIGHT (FEET)	12	14	16	18	20	22	24	30
30	68	92	121	151	286	225	268	
40	100	135	177	224	276	332	394	617
50	133	183	238	302	373	452	538	840
60	172	234	306	387	478	579	689	1076

HOW TO FIGURE CORN ACREAGE

(1) $\text{No. of acres} = \frac{\text{Area in sq. ft.}}{43,560}$

(2) $\text{No. of acres} = \frac{\text{Area in sq. yds.}}{4,840}$

(3) $\text{No. of acres} = \frac{\text{Area in sq. rods}}{160}$

(4) $\text{No. of acres} = \frac{\text{Area in sq. chains}}{10}$

(5) No. of acres = Area in sq. miles x 640

Length of Rows	20 in.	24 in.	28 in.	30 in.	32 in.	36 in.	38 in.	40 in.
	(Number of rows to make an acre)							
40 rods	39.6	33.0	33.7	26.4	24.7	22.2	20.8	19.8
50 rods	31.6	26.4	26.9	21.1	19.8	17.6	16.6	15.8
60 rods	26.4	22.0	22.4	17.6	16.5	14.7	13.9	13.2
70 rods	22.6	18.8	19.2	15.1	14.1	12.6	11.9	11.3
80 rods	19.8	16.5	16.8	13.2	12.7	11.1	10.4	9.9
90 rods	17.6	14.7	15.0	11.7	11.0	9.8	9.3	8.8
100 rods	15.8	13.2	13.4	10.6	9.9	8.8	8.3	7.9
110 rods	14.2	12.0	12.1	9.6	9.0	8.1	7.6	7.1
120 rods	13.0	11.0	11.1	8.8	8.2	7.3	6.9	6.5
130 rods	12.0	10.1	10.2	8.1	7.6	6.6	6.4	6.0
140 rods	11.2	9.4	9.5	7.6	7.0	6.2	5.9	5.6
150 rods	10.6	8.8	9.0	7.0	6.6	5.8	5.5	5.3
160 rods	9.8	8.2	8.3	6.6	5.5	5.2	5.5	4.9

To compute acres in a field or portion of a field.

Example: If rows are 36 ins. apart and 60 rods long, then 14.7 rows make an acre.

8. MARKETING CORN

8.1 Performance Objective

Given a written check-out activity concerning marketing corn, student will complete the activity with 80 percent accuracy.

8.2 Teaching-Learning Activities

a. This section on marketing corn can best be taught using the problem-solving procedure. Prepare appropriate problems for class use.

b. Take a field trip to:

(1) local elevator
(2) grain terminal
(3) Chicago Board of Trade

c. Use a marketing specialist as a resource person.

d. Obtain information on the various types of marketing.

e. Make and use transparencies or handouts from the transparency masters.

8.2.1 Market corn to the best advantage.

Marketing corn can be done by one or more of several methods. The decision on which method to use will need to be made by the farmer based upon the market situation, outlook, and the individual grain handling situation. The choices of ways to market are:

a. See future contract for a given month.

b. Sell on a forward cash contract for delivery at a specified time.

c. Sell at harvest.

d. Store on the farm and sell futures contract for a given month.

e. Store commercially and sell futures contract for a given month.

f. Store on the farm and sell later.

g. Store commercially and sell later.

h. Feed grain to livestock.

8.2.2 [illegible] market outlets for corn.

Most grain in Kentucky is sold through local grain elevators. Other outlets for corn are feed mills, mills which process corn into food products for human consumption, distilleries, feedlot operators, and truckers.

8.2.3 Determine market grade requirements for corn. (See transparency masters 8.2.3a.)

a. The grade requirements for yellow or white shelled corn and the maximum limits of each item are shown in transparency master 8.2.3a.

b. To be classed as yellow corn there shall be no more than 5.0 percent of corn of other colors. To be classed as white corn there shall be no more than 2.0 percent of corn of other colors.

c. Special grades also may be given corn:

(1) Weevily - infested with live weevils or other insects.
(2) Sample Grade (Stones) - corn containing in excess of seven inseparable stones or cinders in sample which have a total weight in excess of 0.2 percent.
(3) Sample Grade (Distinctly Low Quality) - corn containing large pieces of glass, stones, or pieces of concrete, or corn containing rodent excreta in excess of 0.2 percent.

d. Most yellow is purchased on No. 2 grade and white on a No. 1 grade.

8.2.4 Discount the price of corn for test weight, moisture and damage, and calculate corn shrinkage. (See transparency masters 8.2.4a, 8.2.4b, and 8.2.4c.)

Figuring a discount for moisture above the 15.5 percent level can be done by different methods. In the discounted method, the corn is bought at wet bushel weight and the seller is charged so much for each point of moisture above 15.5 percent. As the market price of corn goes up, the price per point of moisture increases.

Example: 1,000 bushels of corn having 21.5 percent moisture with a discount of 5 cents per point above 15.5 percent moisture and corn selling price $2.50 per bushel.

Corn: 1,000 bushels x $2.50 per bushel selling price = $2,500
Moisture 21.5 percent - 15.5 percent = 6 percent moisture above market level
6 points moisture x 5 cents per point = 30 cents discount per bushel for moisture
1,000 bushels x .30 per bushel = $300 moisture content
$2,500 - $300 = $2,200 received for grain

The shrinkage method uses a conversion factor to convert wet grain sold to dry bushel weight and then the elevator usually has a drying charge for each point of moisture above 15.5 percent.

Example: 1,000 bushels of 21.5 percent corn; the conversion factor is 7.60 to convert to 15.5 percent moisture. The selling price of $2.50 per bushel would have a drying charge of 2 cents per point of moisture (at a local grain elevator). If the grain had been $2.80 per bushel at the elevator, the charge would have been 2½ cents per bushel per point of moisture.

Corn: 1,000 bushels x .929 conversion factor = 929 bushels
929 bushels x $2.50 per bushel - $2,322
Moisture 21.5 percent - 15.5 percent = 6 percent or points
6 points moisture x 2 cents per point = 12 cents per bushel drying charge
1,000 bushels corn x 12 cents per bushel = $120
$2,322 - $120 = $2,202 received for grain

8.2.5 Identify sources, collect and interpret corn market information.

The source of corn market information can be gathered from the following:

a. Futures market trends and prices.

b. Carryover of grain from previous crop year.

c. Number of livestock on hand in the United States.

d. Current crop production, number of acres.

e. Number of livestock projected to be produced in coming year.

f. Weather conditions in corn growing areas.

g. Export outlook.

h. Overall economy.

i. Market demands - for corn or livestock which consume corn.

Many readily available agricultural market reports provide much of the above information.

8.2.6 Select the period when it would be most profitable to market corn.

In recent years the set pattern of low harvest prices and high late spring and summer prices has changed somewhat due to more farm storage facilities, more activity on the futures market, and more exporting of corn. The season price pattern for a 10-year average from 1967 to 1976 was:

Price -	Harvest Sept-Nov	Winter Dec-Feb	Spring Mar-May	Summer June-Aug
Below Average	7 yrs.	2 yrs.	1 yr.	2 yrs.
Above Average	3	8	9	8
You Will Get				
Highest Price	1	1	3	5
Lowest Price	7	Never	1	2

In a study of peak prices for given months from 1967 to 1976, August had 3 years with the top price, July had 2 years, and February had 2 years with the highest price for corn.

8.2.7 Explain how and where local corn prices are set.

The price paid locally by the grain dealer is based upon the Chicago market and what can be received at the terminals at New Orleans. Then the local basis is determined by various local situations. Basis is the difference between the Chicago price and the local price. This basis difference changes during the marketing year. It is the greatest at harvest and the lowest late in the summer. Items which affect the basis are: transportation costs, time of corn market season, location of grain surplus or grain deficient production area, international supply and demand for corn, and the dealer's ability to handle and move grain.

8.2.8 Describe the supply and demand of corn.

A high percentage of the corn produced in the United States is consumed by the livestock; then exports take the next highest amount of corn, and finally processing uses a small percentage. For demand to be high for corn there must be normal or above numbers of cattle, swine and poultry to consume grain, as well as normal or heavy exporting. Supply of corn is affected by number of acres and bushels per acre produced which are influenced by price, weather, cost of production, and profitability of other crops.

8.3 Supplementary Materials

References: 1. Modern Corn Production.

2. Grain Merchandising and Futures in Kentucky.

Filmstrips: 1. "Determining Market Grades of Corn."

2. "Factors Affecting Classes and Grades of Shelled Corn."

Movies: 1. "The Vital Force."

2. "Your Profit in Futures."

Transparency Masters:

1. 8.2.3a, "Grades and Grade Requirements for Yellow, White, and Mixed Corn."
2. 8.2.4a, "Apparent and Actual Prices and Discounts in Marketing High Moisture Corn."
3. 8.2.4b, "Shrinkage Schedule and Drying Charges for Shelled Corn."
4. 8.2.4c, "Correcting Yield for Moisture - Pounds Needed to Equal One Bushel #2 Corn."

8.4 Check-Out Activities

1. Most corn sold in Kentucky is to local grain elevators. T F
2. Most yellow shelled corn is purchased on as number 2 grade. T F
3. White corn sold as white corn cannot contain more than what percent other colors of corn? ____
4. Number 1 grade of corn has a test weight of how many pounds? ____
5. Number 2 corn cannot have more than what percent moisture? ____
6. There is more than one method of figuring moisture discount. T F
7. Prices for corn are usually highest at harvest time. T F
8. The corn prices are determined by the Kansas City market. T F

ANSWERS:

1. True
2. True
3. 2 percent
4. 56 pounds
5. 15.5 percent
6. True
7. False
8. False

Grades and grade requirements for yellow, white, and mixed corn

Grade	Minimum test weight per bushel	Maximum limits of—			
		Moisture	Broken corn and foreign material	Damaged kernels	
				Total	Heat damaged kernels
	Pounds	Percent	Percent	Percent	Percent
1	56	14.0	2.0	3.0	0.1
2	54	15.5	3.0	5.0	.2
3	52	17.5	4.0	7.0	.5
4	49	20.0	5.0	10.0	1.0
5	46	23.0	7.0	15.0	3.0

APPARENT AND ACTUAL PRICES AND DISCOUNTS IN MARKETING HIGH-MOISTURE CORN[1]

Moisture Percent	Apparent Discount Per Bushel Cents	Apparent Price Per Bushel Cents	Actual Price Per Bushel[2] Cents	Actual Discount for Marketing High-moisture Corn Cents
15.5	0	100	100.0	0.0
16.0	1	99	99.4	0.4
16.5	2	98	98.8	0.8
17.0	3	97	98.2	1.2
17.5	4	96	97.6	1.6
18.0	5	95	97.0	2.0
18.5	6	94	96.4	2.4
19.0	7	93	95.9	2.9
19.5	8	92	95.3	3.3
20.0	9	91	94.7	3.7
20.5	10	90	94.1	4.1
21.0	11	89	93.5	4.5
21.5	12	88	92.9	4.9
22.0	13	87	92.3	5.3
22.5	14	86	91.7	5.7
23.0	15	85	91.1	6.1
23.5	16	84	90.5	6.5
24.0	17	83	89.9	6.9
24.5	18	82	89.3	7.3
25.0	19	81	88.8	7.8

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[1] When corn sells for $1 per bushel, moisture discount rate is 1 cent per each 1/2 Percent over 15.5.

[2] Price adjusted for extra weight due to moisture above 15.5 percent.

TM 8.2.4b

SHRINKAGE SCHEDULE AND DRYING CHARGES FOR SHELLED CORN

Moisture	Shrinkage	Drying Charge Per Wet Bu.	Moisture	Shrinkage	Drying Charge Per Wet Bu.
15.6 to 16.0	1.0%	0 ¢	23.1 to 23.5	10.4%	5 3/4 ¢
16.1 to 16.5	1.6	1/2	23.6 to 24.0	11.0	6
16.6 to 17.1	2.2	1	24.1 to 24.5	11.7	6 1/4
17.1 to 17.5	2.8	1 1/2	24.6 to 25.0	12.3	6 1/2
17.6 to 18.0	3.4	2	25.1 to 25.5	13.0	6 3/4
18.1 to 18.5	4.0	2 1/2	25.6 to 26.0	13.7	7
18.6 to 19.0	4.6	3	26.1 to 26.5	14.4	7 1/4
19.1 to 19.5	5.2	3 1/2	26.6 to 27.0	15.1	7 1/2
19.6 to 20.0	5.8	4	27.1 to 27.5	15.8	7 3/4
20.1 to 20.5	6.5	4 1/4	27.6 to 28.0	16.6	8
20.6 to 21.0	7.1	4 1/2	28.1 to 28.5	17.3	8
21.1 to 21.5	7.8	4 3/4	28.6 to 29.0	18.1	8
21.6 to 22.0	8.4	5	29.1 to 29.5	18.8	8
22.1 to 22.5	9.1	5 1/4	29.6 to 30.0	19.6	8
22.6 to 23.0	9.7	5 1/2			

Correcting yield for moisture Pounds needed to equal 1 bu. #2 corn

Percent moisture	A Ear corn	B Shelled corn
15.0	67.89	55.67
15.5	68.40	56.00
16.0	68.94	56.33
16.5	69.51	56.60
17.0	70.09	57.01
17.5	70.69	57.36
18.0	71.31	57.70
18.5	71.95	58.06
19.0	72.60	58.42
19.5	73.27	58.78
20.0	73.96	59.15
20.5	74.60	59.52
21.0	75.36	59.90
22.0	76.79	60.66
23.0	78.25	61.45
24.0	79.76	62.26
25.0	81.25	63.09
30.0	88.50	67.60

9. PRODUCTION ECONOMICS

9.1 Performance Objective

Given a written check-out activity concerning production economics, the student will complete the activity with 80 percent accuracy.

9.2 Teaching-Learning Activities

a. This section on production economics can best be taught using the problem-solving procedure. Prepare appropriate problems for class use.

b. Have students bring in record books of their farm showing cost-returns on corn production.

c. Use record summaries from student projects to show cost-returns for the department for previous years.

d. Obtain the latest cost-return data from the University of Kentucky.

e. Use extension personnel, an outstanding farmer or personnel from financial institutions such as banks, Farmers Home Administration, Production Credit Association, or Federal Land Bank, as resource persons.

f. Make and use transparencies and/or handouts made from transparency masters.

9.2.1 Keep and analyze production records for corn.

Records are important in corn production as they are important in other farm enterprise. With records of your items of cost and the returns, you can compare these against other corn producers in your area or county.

The items of costs fall into two groups. Fixed costs are those costs that occur regardless whether the crop is produced or not. Variable (out-of-pocket or cash) costs are those costs that are affected by the amount of each item used and the production over which the cost may be spread. Fixed cost items are: land, buildings, machinery depreciation, and taxes. Land fixed costs will vary greatly from one area to another. Variable cost items are: fertilizer, lime, seed, chemicals, machinery operation costs, drying costs, interest on variable costs, labor, and marketing.

The returns will be the amount received from the sale of the grain. The returns minus the costs equal the net returns.

9.2.2 Budget the annual cost and returns in corn production.

Before beginning to produce a corn crop, a budget should be developed so the corn producer will know about what the cost of producing the corn crop will be. An example of a budget for producing a corn crop conventionally, no-till, and minimum till have been taken from Farm Planning Manual for Kentucky Farmers and are included as transparency masters 9.2.2a, 9.2.2b, and 9.2.2c.

Land costs, storage availability and other factors vary from one area to another and figures used in a budget should be as accurate for a given farm as possible.

9.2.3 Set realistic goals for a corn production enterprise.

Each corn grower should set goals which can be obtained on one's own farm. Some averages that the grower can use to arrive at realistic goals are: state averages, county averages, farm analysis group averages, and yields of corn produced by neighbors. The same five-year averages for 1973-1977 are:

Kentucky	87.2 bu.
Bourbon County, highest	99.2 bu.
Union County	98.7 bu.
Perry County	63.5 bu.
McCreary County	60.0 bu.
Pennyroyal Area Farm Analysis, 1975-77	114.3 bu.

9.2.4 Analyze the economic features of various cultivation practices used in corn production.

Figures for conventional tillage, no-tillage, and minimum tillage are shown in transparency masters 9.2.2a, 9.2.2b, and 9.2.2c. Compare the costs of fertilizer, tillage and compare total costs and net returns using each method.

9.2.5 Energy Utilization in Agriculture.

a. A most serious problem in the United States is that of obtaining and conserving energy. The problem is very complex and solving it requires changes in values and attitudes. This makes it even more difficult to deal with, especially by officials who want to be re-elected.

b. The most efficient production based on energy input as compared with production measured in btu's is the very primitive type of agriculture using no machinery and little or no other energy inputs like fertilizer. This higher-labor intensive production requires a great deal of labor per bushel as compared to modern methods. Many persons would not be willing, under present circumstances, to revert to a great deal of manual labor.

Another problem with reducing inputs is that it usually lowers production. Present world food needs would not allow any great reductions in food production without causing mass starvation.

c. While some energy options may not be practical, there are many that need careful evaluation and implementation. There are many opportunities for greater efficiency, eliminating waste, and for conservation in most areas of agricultural production.

d. Corn production is a relatively large energy user because it is grown on so many acres. Its production compared to energy used is, however, quite good especially if irrigation is not used. A great deal of research is being done to determine the most energy-efficient methods of tillage, cultural practices, harvesting, and drying and storing grain. Research is also continuing to discover new and more efficient ways of producing corn. Research is also being conducted to find ways that corn can utilize nitrogen from the air much as legumes do. Since nitrogen fertilizer is a major energy input for corn (especially for no-till in heavy sod), this could be a very important breakthrough.

e. Gasohol and other products which can be made from corn are receiving more attention. Increased efficiency in producing such products plus better utilization of waste from such processes may also improve the energy outlook.

9.3 Supplementary Materials

References:
1. Corn Production and Marketing, Adult Unit 107.
2. Energy Usage in Agricultural Production, AEES-11.
3. Farm Planning Manual for Kentucky Farmers, Agricultural Economics Extension Information, Series No. 11.
4. Modern Corn Production.
5. Producing Farm Crops.

Movies:
1. "Fuel for the Food Machine."
2. "The Energy Savers."

Transparency Masters:
1. 9.2.2a, "Costs of Producing Corn Using Conventional Tillage Methods."
2. 9.2.2b, "Costs of Producing Corn Using No-Till Methods."
3. 9.2.2c, "Costs of Producing Corn Using Minimum Tillage Methods."

9.4 Check-Out Activities

1. Fixed costs are those that occur regardless of the crop being produced or not. T F

2. Variable costs are those costs that you pay based upon the amount of the items used. T F

3. Land is a fixed cost item. T F

4. Seed is a fixed cost item. T F

5. Fertilizer is a variable cost item. T F

6. What you have remaining after taking all the costs from the total receipts is called __________.

7. Nitrogen fertilizer is one of the most important uses of energy in growing corn. T F

8. Corn is not an important user of energy. T F

ANSWERS:

1. True
2. True
3. True
4. False
5. True
6. Net returns
7. True
8. False

TM 9.2.2a

COSTS OF PRODUCING CORN USING
CONVENTIONAL TILLAGE METHODS

EXPECTED RETURNS			
GRAIN	$ 2.50 X	115.00 BU.	$ 287.50
TOTAL RETURNS			287.50
COSTS OF PRODUCTION			
CASH COSTS			
NITROGEN	$ 0.18 X	120.00 LBS.	$ 21.60
PHOSPHATE	$ 0.15 X	60.00 LBS.	$ 9.00
POTASH	$ 0.08 X	60.00 LBS.	$ 4.50
LIME	$ 6.00 X	0.50 TONS	$ 3.00
PLANTS OR SEED	$ 0.75 X	16.00 LBS.	$ 12.00
CHEMICALS	$ 10.50 X	1. ACRE	$ 10.50
BUILDING AND EQUIP. INS.	$ 0.015 X	300.00 $=	$ 4.50
BLDG AND EQUIP REPAIRS	$ 0.015 X	300.00 $=	$ 4.50
MACHINERY OPERATION	$ 4.00 X	5.00 HRS.	$ 20.00
MARKETING AND HAULING	$ 0.15 X	100.00 BU.	$ 15.00
TOTAL			104.60
OVERHEAD COSTS			
MACHINERY DEPRECIATION	10.0 %	X $ 175.00	$ 17.50
BUILDING DEPRECIATION	5.0 %	X $ 125.00	$ 6.25
INTEREST ON MACHINERY	4.5 %	X $ 175.00	$ 7.88
INTEREST ON BUILDINGS	4.5 %	X $ 125.00	$ 5.63
INTEREST ON LAND	5.0 %	X $ 800.00	$ 40.00
TAXES	0.8 %	X $ 925.00	$ 7.40
TOTAL OVERHEAD			84.65
LABOR COSTS			
HOURS AND WAGES	$ 3.00 X	5.00 HRS.	$ 15.00
TOTAL LABOR			15.00
TOTAL COST			204.25
NET RETURNS			83.25
CAPITAL INVESTMENT			
LAND	$ 800.00 X	1. ACRE	$ 800.00
MACHINERY	$ 175.00 X	1. ACRE	$ 175.00
BUILDINGS	$ 125.00 X	1. ACRE	$ 125.00
TOT. INVEST.			1100.00

Source: Farm Planning Manual for Kentucky Farmers.

COSTS OF PRODUCING CORN
USING NO-TILL METHODS

EXPECTED RETURNS					
GRAIN	$ 2.50	X	115.00 BU.	$	287.50
TOTAL RETURNS					287.50
COSTS OF PRODUCTION					
CASH COSTS					
NITROGEN	$ 0.18	X	150.00 LBS.	$	27.00
PHOSPHATE	$ 0.15	X	60.00 LBS.	$	9.00
POTASH	$ 0.08	X	60.00 LBS.	$	4.50
LIME	$ 6.00	X	0.50 TONS	$	3.00
PLANTS OR SEED	$ 0.75	X	18.00 LBS.	$	13.50
CHEMICALS	$ 21.00	X	1. ACRE	$	21.00
BUILDING AND EQUIP. INS.	$ 0.015	X	240.00 $=	$	3.60
BLDG AND EQUIP REPAIRS	$ 0.015	X	240.00 $=	$	3.60
MACHINERY OPERATION	$ 4.00	X	3.00 HRS.	$	12.00
MARKETING AND HAULING	$ 0.15	X	100.00 BU.	$	15.00
TOTAL					112.20
OVERHEAD COSTS					
MACHINERY DEPRECIATION	10.0 %	X	$ 115.00	$	11.50
BUILDING DEPRECIATION	5.0 %	X	$ 125.00	$	6.25
INTEREST ON MACHINERY	4.5 %	X	$ 115.00	$	5.18
INTEREST ON BUILDINGS	4.5 %	X	$ 125.00	$	5.63
INTEREST ON LAND	5.0 %	X	$ 800.00	$	40.00
TAXES	0.8 %	X	$ 925.00	$	7.40
TOTAL OVERHEAD					75.95
LABOR COSTS					
HOURS AND WAGES	$ 3.00	X	3.00 HRS.	$	9.00
TOTAL LABOR					9.00
TOTAL COST					197.15
NET RETURNS					90.35
CAPITAL INVESTMENT					
LAND	$ 800.00	X	1. ACRE	$	800.00
MACHINERY	$ 115.00	X	1. ACRE	$	115.00
BUILDINGS	$ 125.00	X	1. ACRE	$	125.00
TOT. INVEST.					1040.00

Source: *Farm Planning Manual for Kentucky Farmers.*

COSTS OF PRODUCING CORN USING MINIMUM TILLAGE METHODS

EXPECTED RETURNS				
GRAIN	$ 2.50 X	115.00	BU.	$ 287.50
TOTAL RETURNS				287.50
COSTS OF PRODUCTION				
CASH COSTS				
NITROGEN	$ 0.18 X	150.00	LBS.	$ 27.00
PHOSPHATE	$ 0.15 X	60.00	LBS.	$ 9.00
POTASH	$ 0.08 X	60.00	LBS.	$ 4.50
LIME	$ 6.00 X	0.50	TONS	$ 3.00
PLANTS OR SEED	$ 0.75 X	18.00	LBS.	$ 13.50
CHEMICALS	$ 17.20 X	1.	ACRE	$ 17.20
BUILDING AND EQUIP. INS.	$ 0.015 X	260.00	$=	$ 3.90
BLDG AND EQUIP.REPAIRS	$ 0.015 X	260.00	$=	$ 3.90
MACHINERY OPERATION	$ 4.00 X	4.00	HRS.	$ 16.00
MARKETING AND HAULING	$ 0.10 X	100.00	BU.	$ 10.00
TOTAL				108.00
OVERHEAD COSTS				
MACHINERY DEPRECIATION	10.0 %	X $ 135.00		$ 13.50
BUILDING DEPRECIATION	5.0 %	X $ 125.00		$ 6.25
INTEREST ON MACHINERY	4.5 %	X $ 135.00		$ 6.08
INTEREST ON BUILDINGS	4.5 %	X $ 125.00		$ 5.63
INTEREST ON LAND	5.0 %	X $ 800.00		$ 40.00
TAXES	0.8 %	X $ 925.00		$ 7.40
TOTAL OVERHEAD				78.85
LABOR COSTS				
HOURS AND WAGES	$ 3.00 X	4.00	HRS.	$ 12.00
TOTAL LABOR				12.00
TOTAL COST				198.85
NET RETURNS				88.65
CAPITAL INVESTMENT				
LAND	$ 800.00 X	1.	ACRE	$ 800.00
MACHINERY	$ 135.00 X	1.	ACRE	$ 135.00
BUILDINGS	$ 125.00 X	1.	ACRE	$ 125.00
TOT. INVEST.				1060.00

Source: Farm Planning Manual for Kentucky Farmers.

LIST OF RESOURCES

Books

Approved Practices in Crop Production, 2nd. ed., Elwood A. Brickbauer and W. P. Mortenson. The Interstate, Danville, Illinois, 1978. 395 pages.

Crop Production, 4th ed., Richard J. Delorit, Louis J. Greub, and Henry L. Ahlgren. Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1974. 744 pages.

Corn Production and Marketing, Adult Unit 107, Glyde Grace, Jr. Adult Curriculum Materials Project, Department of Vocational Education, College of Education, University of Kentucky, Lexington, Kentucky, 1974. 104 pages.

Crop Storage and Handling, Adult Unit 104, James L. Hammer. Adult Curriculum Materials Project, Department of Vocational Education, College of Education, University of Kentucky, Lexington, Kentucky, 1972. 146 pages.

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*These are available free of charge from your county cooperative extension office or can be ordered in quantity (up to one per each two students in your largest class) through the Department of Vocational Education, University of Kentucky, Room 43 Dickey Hall, Lexington, Kentucky 40506.

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Nematodes on Corn, Pm 722. 1977. 2 pages.

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Diseases of Corn in the Midwest, Circular 967. 1970. 26 pages.

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Corn Insects--Below Ground, E-84. Purdue University, Cooperative Extension Service, West Lafayette, Indiana 47907. 1978. 2 pages.

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The DeKalk 5-Point Profit Program for Corn. DeKalb Agricultural Research, Inc., Sycamore Road, DeKalb, Illinois 60115. 14 pages.

The Migro Complete Corn Farmers Handbook. Migro Hybrids, Box 7, Mitchell, Indiana 47446. 80 pages.

The Ten Chromosomes of Maize. DeKalb Agricultural Association, Inc., Sycamore Road, DeKalb, Illinois. 1967. 35 pages.

Tobacco Production, Unit in this series. Department of Vocational Education, University of Kentucky, Lexington, Kentucky 40506.

What Size Seed Corn Should You Buy? DeKalb Agricultural Research, Inc., Sycamore Road, DeKalb, Illinois 60115. 1969. 4 pages.

1979 Hybrids-Southern States. Southern States Cooperative, Box 26234, Richmond, Virginia 23260. 1979. 32 pages.

Most seed companies have publications which are very useful.

Movies

"A Little Better Timing," (Nitrogen Fertilizer). The Dow Chemical Company, 15 minutes.

"Breakthrough in Combining." Venard Films, 21½ minutes.

"Bringing It Home," (Combining). Ideal Pictures Film Library, 18 minutes.

"Combine Safety." Farm Film Foundation, 14 minutes.

"Coming Out Ahead," (Corn heads-harvesting). Ideal Pictures Film Library, 10 minutes.

"Cornlage." Venard Films, 19½ minutes.

"Fuel for the Food Machine." Farm Film Foundation, 30 minutes.

"Genetics of Tomorrow." Modern Talking Picture Service, 6 minutes.

"Golden Link," (Hybrid corn). Farm Film Foundation, 13½ minutes.

"Growing the Good Seed." Venard Films, 9 minutes.

"High Moisture Corn Farming." Venard Films, 18 minutes.

"Hole in the Pocket," (Corn harvesting losses). Modern Talking Picture Service, 27 minutes.

"Hybrid Vigor: Key to Abundance." Farm Film Foundation, 28 minutes.

"Invisible Acres." Farm Film Foundation, 30 minutes.

"Look to the Harvest, (Axial flow combines). Farm Film Foundation, 12½ minutes.

"Pesticides: Fundamentals of Proper Application." Venard Films, 13 minutes.

"Pesticides in Focus." Shell Film Library, 25 minutes.

"Picking the Winners." Farm Film Foundation, 21 minutes.

"Positive Placement of Fertilizer." Farm Film Foundation, 12½ minutes.

"Primer for Professionals," (Anhydrous ammonia). The Dow Chemical Company, 19 minutes.

"Soil Insect Control." Modern Talking Picture Service.

"The Energy Savers," (Drying grain). Venard Films, 10 minutes.

"The Man, The Record." Venard Films, 5 minutes.

"The Proof is in the Harvest." Ideal Pictures Film Library, 10 minutes.

"The Vital Force," (Futures trading). Venard Films, 16 minutes.

"Today's Choice," (Hybrid seed production). Modern Talking Picture Service, 10 minutes.

"Your Profit in Futures." Farm Film Foundation, 14 minutes.

"Why Dry Corn?" Venard Films, 13½ minutes.

Sources of Movies

Allis Chalmers Film Library, 4431 W. North Avenue, Milwaukee, Wisconsin 53208.

Farm Film Foundation, Suite 424 - Southern Building, 1425 H Street, N. W., Washington, D.C. 20005.

Ideal Pictures Film Library, 4431 W. North Avenue, Milwaukee, Wisconsin 53208.

Modern Talking Picture Service, 1687 Elmhurst Road, Elk Grove Village, Illinois 60007.

Shell Film Library, 1433 Sadlier Circle W. Drive, Indianapolis, Indiana 46239.

The Dow Chemical Company, Attention: Gary S. Bednarczyk, Audio-Visual Department, 2030 Dow Center, Midland, Michigan 48640.

Venard Films, Ltd., Box 1332, Peoria, Illinois 61654.

The above movies are available free except for return postage. Movies must be ordered at least one to two months in advance depending on the source. Chances of receiving the film you want when you want it improve by ordering it early.

Slides and Slidefilms

"Calibrating and Applying Pesticides Safely," (52 slides or frames). Vocational Agriculture Service, College of Agriculture, University of Illinois, 434 Mumford Hall, Urbana, Illinois 61801. Price: Slides, $11.95; Slidefilm, $6.74.

"Combines, Principles of Operation" (39 slides and illustrated script). Ohio Agricultural Education Curriculum Materials Service, The Ohio State University, Room 254, 2120 Fyffe Road, Columbus, Ohio 43210. 1968. Price: $8.60.

"Controlling Giant Foxtail," (37 frames). Vocational Agriculture Service, College of Agriculture, University of Illinois, 434 Mumford Hall, Urbana, Illinois 61801. Price: $4.44.

"Corn Root Development" (21 slides and script). Ohio Agricultural Education Curriculum Service, The Ohio State University, Room 254, 2120 Fyffe Road, Columbus, Ohio 43210. Price: $4.80.

"Determining Market Grades of Corn," (47 frames). Vocational Agricultural Service, College of Agriculture, University of Illinois, 434 Mumford Hall, Urbana, Illinois 61801. Price: $5.64.

"Efficient Machine Harvesting," (21 slides), D. M. Byg. Ohio Agricultural Curriculum Materials Service, The Ohio State University, Room 254, 2120 Fyffe Road, Columbus, Ohio 43210. 1965. Price: $4.80.

"Factors Affecting Classes/Grades of Shelled Corn," (42 frames). Vocational Agriculture Service, College of Agriculture, University of Illinois, 434 Mumford Hall, Urbana, Illinois 61801. Price: $5.04.

"Grow Top Profit Corn" (44 slides, script, and cassette tape available). Potash and Phosphate Institute, 2801 Buford Highway, N. E.,Suite 445, Atlanta, Georgia 30329. Price: Slides, $15.00; Cassette, $7.00.

"Identification of Weed Seedlings, Broadleaves," Parts I and II (90 slides total or 45 frames each). Vocational Agriculture Service, College of Agriculture, University of Illinois, 434 Mumford Hall, Urbana, Illinois 61801. Price: Slides, $19.80; Slidefilms, $5.40 each or $10.80 for both.

"Identification of Weed Seedlings, Grasses," (42 slides or frames). Vocational Agriculture Service, College of Agriculture, University of Illinois, 434 Mumford Hall, Urbana, Illinois 61801. Price: Slides, $9.25; Slidefilms, $5.04.

"Identifying Common Insect Pests," (73 slides or frames). Vocational Agriculture Service, College of Agriculture, University of Illinois, 434 Mumford Hall, Urbana, Illinois 61801. Price: Slides, $16.80; Slidefilms, $9.51.

"Planting Corn," (70 slides or frames). Vocational Agriculture Service, College of Agriculture, University of Illinois, 434 Mumford Hall, Urbana, Illinois 61801. Price: Slides, $15.40; Slidefilms, $8.40.

"Producing Hybrid Seed Corn," (68 frames). Vocational Agriculture Service, College of Agriculture, University of Illinois, 434 Mumford Hall, Urbana, Illinois 61801. Price: $8.16.

"Seed Production of Corn, Soybeans, and Small Grains" (70 slides and script). Ohio Agricultural Education Curriculum Materials Service, The Ohio State University, Room 254, 2120 Fyffe Road, Columbus, Ohio 43210. Price: $15.40.

"Seed Quality - A Major Factor in Crop Yields," (39 frames). Vocational Agriculture Service, College of Agriculture, University of Illinois 61801. Price: $4.68.

"Selecting and Handling Pesticides," (62 slides or slidefilms). Vocational Agriculture Service, College of Agriculture, University of Illinois, 434 Mumford Hall, Urbana, Illinois 61801. Price: Slides, $16.60; Slidefilms, $8.19.

"The Late Growth of Corn" (28 slides and script). Ohio Agricultural Education Curriculum Service, The Ohio State University, Room 254, 2120 Fyffe Road, Columbus, Ohio 43210. Price: $6.40.

"The Wicked World of Weeds," (77 slides or frames). Vocational Agriculture Service, College of Agriculture, University of Illinois, 434 Mumford Hall, Urbana, Illinois 61801. Price: Slides, $16.95; Slidefilm, $9.24.

"Tillage Systems for Corn (70 slides and script). Ohio Agricultural Education Curriculum Service, The Ohio State University, Room 254, 2120 Fyffe Road, Columbus, Ohio 43210. Price: $15.40.

"Understanding and Safe Use of Pesticides," (72 slides or frames). Vocational Agriculture Service, College of Agriculture, University of Illinois, 434 Mumford Hall, Urbana, Illinois 61801. Price: Slides, $16.60; Slidefilms, $9.39.

"Weed Identification," (78 slides or frames). Vocational Agriculture Service, College of Agriculture, University of Illinois, 434 Mumford Hall, Urbana, Illinois 61801. Price: Slides, $17.15; Slidefilms, $9.36.